# ASSOCIATIONS BETWEEN THE PERFORMANCE IN THE ENTRANCE EXAM AND ACADEMIC PERFORMANCE AT UFMG

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**Abstract**

Federal University of Minas Gerais (UFMG) implemented some recent changes in the entrance exam that may impact the selection process, in particular associations between performances in the entrance exams and posterior academic performance in the university. Differences between population groups in the entrance exams were much greater than for GPAs. Besides, differences in earlier semesters were larger than in later ones. Both results clearly indicate that minorities catch-up while in the university. For the UFMG´s own first stage, Portuguese, mathematics and science exams had a larger predictive power, while the humanities and foreign language exams played smaller roles in predicting GPA outcomes. When the ENEM was used as a first stage of the selection process, all four exams (language, mathematics, humanities and science) showed positive and significant results. The second stage of UFMG´s exam had a greater predictive power when ENEM was used as the first stage of the selection process.

Key-words: minorities, performance, ENEM, Reuni, UFMG.

DEMOGRAFIA

## 1 - Introduction

Tertiary education attendance in Brazil varies remarkably among different population groups (Pedrosa et al., 2007). Household income, parent´s educational attainment and race are among the most decisive factors that impact the student's probability of attending a higher education institution (Silva and Hasenbalg, 2002). In order to decrease inequalities, many public institutions in Brazil implemented affirmative action policies and also increased the number of slots in the last decades (Francis and Tannuri-Pianto, 2012; Pedrosa et al, 2007; Telles and Paixão, 2013). As a consequence, there was an increase in the proportion of black/brown/indigenous students and those from low-income families attending public universities in Brazil.

In particular concerning the Federal University of Minas Gerais (UFMG), it was implemented a bonus policy in the entrance exam of 2009, which remained valid with minor changes until the entrance exam of 2012. In 2012 it was approved the national federal law of quotas that was implemented in all federal higher education institutions in Brazil (Telles and Paixão, 2013). The Restructuration and Expansion of Federal Universities (Reuni) policy was also implemented in UFMG and in other public universities, remarkably increasing the number of slots in public federal universities in Brazil between 2008 and 2012.

Moreover, recent changes in the entrance exam may also impact students selection in federal public universities in general and in UFMG in particular. Until recently, most universities had their own exams that differed from other institutions. In the last years, the National Exam of the Secondary Level (ENEM) began to be used in a myriad of public and private institutions as part or as the unique exam of tertiary education students selection (Lima and Machado, 2016).

All these police changes may have influenced several aspects related to public tertiary education in Brazil, in particular associations between performances in the entrance exams and posterior academic performance and achievements in the university. The main objective of this paper is to analyze associations between the performance in the entrance exam of UFMG and the academic performance in the tertiary level at this institution between the years of 2009 and 2012. Other authors discussed similar topics in different settings (Bai and Chi, 2011; Bettinger et al., 2013; Bulman, 2017; Fryer Jr. et al., 2008; Leonard and Jiang, 1999; Loury and Garman, 1993; Rothstein, 2004). However, this paper analyses a developing country with many recent changes in different policies in the selection process of students in public universities. In this period there were the above-mentioned changes in the number of slots, in the affirmative action policy and in the type of exam used to select students. To the best of my knowledge these associations were not yet addressed with Brazilian data.

The paper uses official records of UFMG developed by the Permanent Commission of the Vestibular (COPEVE) and by the Department of Academic Registry (DRCA). The databases were kindly conceded to research purposes and preserve the anonymity of the students. The GPAs in specific semesters of students who entered UFMG in 2009 or in 2012 are analyzed. The explanatory variables of main interest are related to the performance in the entrance exams in UFMG. Besides, other variables such as race, the type of secondary school the student attended and household income, as they are directly related to the attendance of minorities in a high standard public university in Brazil, are also given emphasis.

Besides this introduction, the paper is further divided in four sections. Section two presents the literature review. Section three describes the methodology. Section four depicts the empirical results, and last section concludes the paper.

## 2 – Literature review

There are many factors that are associated with academic performance in different schooling levels. Among these determinants there are the individual´s attributes (sex, race, age, etc), household´s characteristics (parent's schooling level, income, number of siblings, etc.) and school factors (infra-structure, administration, teachers, etc.) (Barros et al., 2001). Many authors described these determinants with Brazilian data using standardized test for elementary and secondary students (Araújo and Siqueira, 2010; Fernandes and Natenzon, 2003; Machado et al., 2008; Rodrigues et al, 2011; Rodrigues et al, 2013; Soares, 2005; Soares and Alvez, 2013).

Nonetheless, the focus here is the tertiary level. In particular for this level in Brazil, Francis and Tannuri-Pianto (2012) observed that males, pardos and indigenous had lower performances. Golgher et al. (2015) verified that students in UFMG that had studied in municipal, federal or private secondary school, that hadn't attended a specific course preparing for the exam of tertiary education institutions (*pré-vestibular*), who did not work or who worked up to twenty hours per week, from a higher income household and who had a computer at home had higher performances.

Besides the above-mentioned socioeconomic and demographic determinants of academic performance in the tertiary level, performances in the entrance exam of tertiary education institutions may also affect academic performance at the tertiary level. Concerning this topic, Bai and Chi (2011) determined whether the Chinese College Entrance Examination score predicted college academic success. They found that the total and subject test scores of this exam predicted undergraduate GPAs for all four years in college. They present other results, and among them, that females had a better GPA than males and that minorities had similar performances than non-minorities.

Loury and Garman (1993) compared SAT scores with GPA of Whites and Blacks attending higher education institutions of different selectivity. The authors observed that higher SAT scores were positively correlated with GPA for Whites and Blacks. Similarly, Fryer Jr. et al. (2008) also analyzed the determinants of college GPA including SAT scores as explanatory variable. They observed a positive correlation between both. In addition, they verified that high school ranks, parental education and neighborhood's racial demographics (fewer blacks) were positively correlated with academic performance.

Following Bettinger et al. (2013), college performance and timely graduation are important policy issues not only for students, but also for society as a whole, as college graduates may promote economic growth in an increasingly skill-based economy. However, as emphasized by these authors, improving college performance and retention can be difficult and costly. They proposed a simple and low-cost change in the way colleges use the ACT exam in their admission decisions. The ACT covers four subjects, Mathematics, English, Reading, and Science, and nearly all colleges use a composite score with the four exams of the test in their admissions process. Similarly to the above-mentioned authors, they observed a strong positive correlation between ACT composite scores and college outcomes. However, they observed that the use of only two exams, Mathematics and English, could effectively predict outcomes in college, GPA and dropout rates for the first and third years. They concluded that Reading and Science tests did not contribute effectively for the student's selections.

Leonard and Jiang (1999) observed that exams such as ACT and SAT under predicted women´s performance in tertiary education, as they obtain higher grades in college than men with identical SAT scores. Thus, females tend to be underrepresented in freshman classes and scholarship competitions at selective public universities, and financial welfare, academic opportunities, and sense of self-esteem of female students are being harmed by the selection process based on the SAT exam. Similarly, Rothstein (2004) observed that female students had higher high school GPAs and freshman GPAs, but lower SATs than males.

Coyle et al. (2011) initially classified subjects as high or low ability using g factor scores from the Armed Services. They observed that SAT positively correlates with GPA and with g, but more strongly with the latter. The authors intended to test the ability hypothesis of Spearman's Law of Diminishing Returns, which predicts that the mean correlation among cognitive tests declines as ability level increases. However, contrary to this prediction, they observed that SAT correlations with GPA were higher for high than low ability subjects. The results were robust and this pattern was also observed for all SAT scores (total, math and verbal).

Last authors described some of the limitations of using exams such as ACT and SAT for student's selection. A number of studies found that exam scores are given disproportionate weight relative to their predictive power and tend to disadvantage lower-income and minority students (Rothstein, 2004). This author stressed that, as a consequence, several colleges had deemphasized the SAT exam in the selection process. He points out that if academic success is the main objective for admissions, other information besides SAT scores should be included in the student's selection. The author analyzed the predictive power of the SAT after including in the models high school GPAs, predicted SAT scores based on SES and the demographic composition of schools. The predictive power of the SAT score, although significant, was small after the inclusion of the other variables in the models.

In this vein, some colleges and universities use high school grade point averages (HS GPA) and class rankings as selection tools (Bulman, 2017). However, these variables may also show some limitations, as a significant fraction of students exhibit positive or negative performance trends during high school. The authors concluded that greater emphasis should be given to later grades, as they are the best predictors of college outcome, including higher GPAs, lower rates of dropout and a better performance in the labor market. They verified that the predictive power of later grades stems from persistent trends in student effort, rather than course-based explanations, when the content of classes taken later in the secondary school better reveals college potential. The authors also observed that the use of later high school performance would not decrease the diversity of the students body in terms of race, gender, and household income.

The use of test scores and other types of information was also proposed by Scott-Clayton et al (2014). They commented that approximately half of the college entrants will not complete any type of degree within six years. An explanation is that many freshmen lack basic academic skills required for college coursework. In order to overcome this difficult, many colleges require incoming students to be inspected for possible attendance in remediation courses. Truly unprepared students might not only do worse academically, but also might depress the achievement of other students. As emphasized by the authors, even though screened, roughly one fourth of the students are severely miss-assigned. The use of high school transcript information, either instead of or in addition to test scores, could significantly reduce assignment errors overall and within each racial/ethnic and gender subgroup.

Similarly to the above-mentioned studies, this paper analyses associations between the performance in the entrance exams of UFMG between 2009 and 2012 and posterior academic performance at this institutions. The focuses are the recent policy changes that occurred in the selection process at this institution. Individual´s attributes, household´s characteristics and school factors are included as controls. The applied methodology is detailed in the next section.

## 3 - Methodology

The methodological section is divided in three subsections. The first describes the policies implemented in UFMG between 2009 and 2016, the second presents the database, and the third details the empirical strategy.

### 3.1 - Policies implemented in UFMG between 2009 and 2016

This subsection describes the main changes that occurred in UFMG regarding the student's selection exam, the number of slots and affirmative action policies. Table 1 presents the changes that occurred in this university between 2009 and 2016. Aranha et al (2012) describe some of these policies in greater detail.

UFMG implemented a bonus policy in the entrance exam of 2009. This policy increased in 10% the grades obtained in the entrance exam for 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 considered themselves Blacks/Browns/Indigenous. This policy with minor changes was valid until the entrance exam of 2012. In 2012 it was approved the national federal law of quotas to be implemented in all federal higher education institutions in four years (Telles and Paixão, 2013). Beginning in entrance exam of 2013, at least 12.5% of the students in each course had to originate from disadvantaged schooling and/or race backgrounds. This number increased to 25%, 37.5% and 50% respectively in the years of 2014, 2015 and 2016.

UFMG also implemented other policies in the period. Mostly due to the Reuni policy, there was a remarkable increase in the number of slots between 2008 and 2012, from 4.6 thousands to 6.6 thousands annually (Aranha et al, 2012; Lima and Machado, 2016). In the period, 27 new courses were created and other 23 courses that already existed increased the number of slots. Nearly all of this increase was in the years 2009 and 2010.

Moreover, there were recent changes in the entrance exam. Until recently, most universities had their own exams. In the last years, the ENEM exam began to be used as part or as the unique exam of tertiary education student's selection (Lima and Machado, 2016). In UFMG, there were two changes in the entrance exam since 2009. Until 2010, there was an UFMG´s exam in two stages. From 2011 and 2013, the ENEM was used as the first stage, while there was an UFMG´s exam for the second stage. Since 2014 the ENEM is used as the sole method of student´s selection (Lima and Machado, 2016).

Table 1 – Policies of student´s selection in UFMG between 2009 and 2013.

| Year | Exam for selection | Slots | Affirmative action policy |
|---|---|---|---|
| 2009 | UFMG exam in the two stages | Increased remarkably | Bonus policy: 10%/15% |
| 2010 | | | |
| 2011 | ENEM in the first stage and UFMG exam in the second | Approximately constant | |
| 2012 | | | |
| 2013 | | | Quota policy: 12.5% |
| 2014 | ENEM as a sole stage | | Quota policy: 25% |
| 2015 | | | Quota policy: 37.5% |
| 2016 | | | Quota policy: 50% |

### 3.2 - Databases

The paper uses as databases official records of UFMG that were developed by the Permanent Commission of the Vestibular (COPEVE) and by the Department of Academic Registry (DRCA). These databases were kindly granted to research purposes and preserve the anonymity of the students. The databases have the results of the entrance exams of all the students that applied for UFMG from 2009 and 2013, the years with available data. Moreover, they contain socioeconomic variables and information regarding affirmative action policies,

as will be detailed in subsection 3.3. This or similar databases were used in other studies (Golgher et al. 2014, 2015), however, these analyses had different approaches and objectives.

The available database for research purposes that enable addressing associations between the performance in the entrance exam and college GPA were for those who entered UFMG between the year of 2009 and 2013. Other more recent but incomplete database are available for affirmative action policies analysis. Thus, I chose to use the first database and the last that had at least GPAs for the first three semesters: 2009 and 2012.

### 3.3 - Empirical strategy

Based on the description of the previous subsection, there are some possibilities of analysis regarding associations between the performance in the entrance exam and posterior academic performance at UFMG: 1) The associations altered due to the change of the exam, as the UFMG´s own exam was replaced by ENEM in the first stage of selection?; 2) The associations altered because of the increase in slots between 2009 and 2011? 3) The associations change when freshmen are compared to sophomores, juniors and seniors? These are the main questions being empirically addressed by this paper.

The dependent variables are the GPA in specific semesters of the students in UFMG. For students who entered UFMG in 2009 there was available data for eight semesters. I selected three of them: the first, the third and the sixth semester. By doing so, I avoided later semesters when many students may had already graduated and could analyze a time trend. For students who entered UFMG in 2012, there was data for the first four semesters. I selected the first and the third in order to make comparisons with the data from 2009.

Given that GPA is continuous and approximately normally distributed, OLS models with robust and clustered standard errors could be used. However, academic performance can only vary between 0 and 5. That is, the variable is censored in both extremes. Thus, double censored Tobit models were used to overcome this data feature and the above-mentioned OLS models are used as a standard of comparison.

Initially, the explanatory variables of main interest are the performances in the first stage of UFMG own exam in 2009 and the results of ENEM of 2012. In the first stage of the selection process all applicants did the same exams. The results of the ENEM´s composition were not included in the first set of analysis in order to make comparison between 2009 and 2012 more insightful. The second stage exams differ depending on the chosen course. To analyze each course separately is not feasible due to small sample limitations. However, group of courses with similar entrance exams in the second stage could be analyzed separately and this analysis was also incorporated in the paper.

As each course has particular exams, groups of courses with similar exams in both analyzed years were created. All individuals did a composition exam. The groups are the following with the exams in brackets: medicine (biochemistry); language and linguistics (Portuguese and history); general engineering, physics, chemistry and geology (physics, chemistry and mathematics); architecture, computers science, statistics and mathematics (physics and mathematics); business, accounting, economics and information science (history, geography and mathematics); agricultural and husbandry sciences, health sciences, biology and dentistry (biology and chemistry); and social science, law and teaching (history and geography).

The other variables of main interest are variables that represent much of the inequality in the attendance in tertiary institutions in Brazil. They are a categorical variable for race, the type of secondary school the student attended and household income. Besides, other explanatory variables include individual´s features (sex; civil status; work load; whether the individual had already graduated; whether the individual had attended a *pré-vestibular*; the student´s previous knowledge in reading foreign languages; and place of residence),

characteristics of the households (the father´s and the mother´s schooling level; household income; and the father´s and the mother's occupation), features related to the student's secondary education (years since high school graduation; regime of the secondary school; and type of secondary school) and assets in the household (domestic servant; fridge; car; and computer). Most of these variables are commonly used in studies that address the determinants of schooling performance in different levels, as described in the theoretical section. Moreover, a dummy for each course was also included in the models.

In a similar vein as Bettinger et al. (2013) and Bulman (2017), I estimated the following equation:

$$GPA_{is} = \alpha_s + \sum_j \beta_{1j} Subject_{1ij} + \sum_k \beta_{2k} Subject_{2ik} + \delta X_i + \varepsilon_{is},$$ where $i$ is the individual, $s$ is semester, $Subject_{1ij}$ is the performance of $i$ in the subject $j$ in the first stage of the selection process, $Subject_{2ik}$ is the performance of $i$ in the subject $k$ in the second stage of the selection process, $X_i$ is a set of controls, and $\varepsilon_{is}$ are the stochastic errors

Inspired by Rothstein (2004), who used the background variables to generate a predicted SAT score for each student in the database, I also estimated predicted values for the sum of all subjects in the first stage and estimated the following equation for GPAs of the first semester:

$$GPA_{i1} = \alpha + \beta_1 pred(Sum\_Subject_{1i}) + \sum_j \beta_{1j} Subject_{1ij} + \varepsilon_i .$$

## 4 - Results

The results are presented in two subsections. The first presents descriptive statistics comparing the performance in the entrance exam and in the tertiary level in specific semesters for selected explanatory variables. The second shows the results of the econometric models.

### 4.1 – Descriptive statistics

Table 2 shows the mean values for the entrance exam performance in the first stage of the UFMG exam and also for the GPA in the first, third and sixth semester for those who entered UFMG in 2009 for selected the explanatory variables. The results of the entrance exam were transformed as a normal distribution with mean zero and variance one. These same modifications were done with the ENEM results in order to make comparison more insightful. The GPAs vary between 0 and 5, but only positive values entered in the statistics to avoid those who evaded temporarily or permanently from UFMG.

There are three main objectives. The first is to observed differences for each category for each explanatory variable. The second is to compare the results of the entrance exam with those for academic performance in the tertiary level. The third is to observe the dynamics of the academic performance for the different groups during student's trajectory in an institution of higher education. Besides, the table details the explanatory variables. The results for those who entered UFMG in 2012 were very similar and they are shown only in table 1 in the appendix.

Some previous explanations are required. Concerning the entrance exam, the UFMG´s own exam in table 2 and ENEM in table 1 in the appendix, only the results of the first stage are given, as all students did the same exam. A more detailed analysis with data for the second stage is performed with econometric models.

The statistical significance of the differences was accessed. For two group comparisons, the means were compared by t-tests. **M** represents the higher value and **m** the lower value if differences were statistically significant. For categorical variables, it was used ANOVA and Bonferroni tests. M1 stands for the highest value, M2 for the second highest and so on for statistically significant differences. If two categories have the same indicator (i.e. M3), the differences between them were not statistically significant.

Some general trends are noticed in table 2. Notice that differences between the categories of the explanatory variables in the entrance exam tend to be more significant than for GPA, that is, the heterogeneity in the results in the entrance exam are greater that for GPA, as described in the theoretical presentation. Besides, differences in the first semester tend to be greater in the third semester, which tend to be larger than in the sixth. This clearly indicates a catching-up of many categories while in the university, at least for those who entered UFMG in 2009. Few categories showed remarkable and significant differences in all period, including the sixth. First, males, although they had a better performance in the entrance exam, they showed a worst GPA in the three semesters in the university without any signaling of catching-up. Similar trends were observed by Leonard and Jiang (1999) and by Rothstein (2004), indicating that females tend to be underrepresented in the university. Those who already had graduated had a worst performance in the entrance exam and a much better GPA in all three semesters. Those who had attended a *pré-vestibular* had similar performances in the entrance exam than those who had not attend these courses, but GPAs of the latter were much higher. Those who had attend a regular or vocational high school had a better performance in the entrance exam and also in the university in all three semesters.

Some other general trends were observed. Some variables related to SES show significant results for the entrance exam, but non-significant or very small differences for GPA, such as civil status, father´s schooling, mother´s schooling, household income, domestic servant in the household, fridge in the household, car in the household and computer in the household. Part of the explanation is due to catching-up effects during the university and part maybe because individuals with higher SES may be overrepresented in more prestigious courses that may present more rigorous evaluations. This point will be addressed in the econometric models. Some variables showed the expected results for the entrance exam and for the first semester and then differences became mostly non-significant, suggesting catching-up, such as race, knowledge of reading foreign languages, and type of secondary school.

Two variables deserve more cautious commentaries. Those who did not work had the best performance and those who worked more than twenty hours per week had the worst performance in the entrance exam, as expected. For GPA, those who worked up to twenty hours had the best performance, suggesting that is feasible to work and study if workloads are not large. Besides, those who worked up to 20 hours weekly may present positively selected non-observables. Differences for years since high school graduation were mostly stable, with the best performance for those who graduated more recently, with a slight tendency of homogenization.

Table 2 – Performance in the entrance exam in UFMG and in selected academic semesters for those who entered UFMG in 2009 for different groups of students

| Variables | Categories | Entrance exam | GPA | | |
|---|---|---|---|---|---|
| | | | First semester | Third semester | Sixth semester |
| Sex | Female | -0.23$^{m}$ | 3.55$^{M}$ | 3.43$^{M}$ | 3.65$^{M}$ |
| | Male | 0.25$^{M}$ | 3.24$^{m}$ | 3.02$^{m}$ | 3.20$^{m}$ |
| Race | Did not declare | 0.25$^{M1}$ | 3.56$^{M1}$ | 3.38$^{M1}$ | 3.49 |
| | White/Asian | 0.18$^{M1}$ | 3.44$^{M2}$ | 3.26$^{M1}$ | 3.47 |

| | | | | | |
|---|---|---|---|---|---|
| | Black/Pardo/Indigenous | -0.25$^{M2}$ | 3.33 $^{M3}$ | 3.18 $^{M2}$ | 3.39 |
| Civil status | Single | 0.04$^{M}$ | 3.41 | 3.24 | 3.43 |
| | Others | -0.62$^{m}$ | 3.32 | 3.28 | 3.55 |
| Work | Do not work | 0.14$^{M1}$ | 3.43$^{M1}$ | 3.24$^{M2}$ | 3.45$^{M1}$ |
| | Up to 20 hours weekly | -0.24$^{M2}$ | 3.43$^{M1}$ | 3.43$^{M1}$ | 3.58$^{M1}$ |
| | More than 20 hours weekly | -0.48$^{M3}$ | 3.27$^{M2}$ | 3.16$^{M2}$ | 3.35$^{M2}$ |
| Already graduated | No | 0.01$^{M}$ | 3.39 $^{M2}$ | 3.22$^{M2}$ | 3.43$^{M2}$ |
| | Yes | -0.21$^{m}$ | 3.68 $^{M1}$ | 3.48$^{M1}$ | 3.65$^{M1}$ |
| Attended *pré-vestibular* | No | -0.02 | 3.46 $^{M1}$ | 3.30$^{M1}$ | 3.50$^{M1}$ |
| | Yes | 0.01 | 3.36 $^{M2}$ | 3.20$^{M2}$ | 3.40$^{M2}$ |
| Read foreign languages | No | -0.62$^{M3}$ | 3.29 $^{M3}$ | 3.21$^{M1.M2}$ | 3.49 |
| | Only Spanish | -0.52$^{M3}$ | 3.34 $^{M2.M3}$ | 3.22$^{M1.M2}$ | 3.49 |
| | Another language | 0.22$^{M2}$ | 3.41 $^{M1.M2}$ | 3.20$^{M2}$ | 3.39 |
| | Two or more languages | 0.34$^{M1}$ | 3.50 $^{M1}$ | 3.34 $^{M1}$ | 3.46 |
| Father´s schooling level | Don't know/did not answer | -0.40 $^{M3.M4}$ | 3.21 $^{M3}$ | 3.13 | 3.41 |
| | Less than elementary | -0.57 $^{M4}$ | 3.32$^{M2.M3}$ | 3.27 | 3.52 |
| | Elementary | -0.42 $^{M3}$ | 3.35 $^{M1.M3}$ | 3.25 | 3.48 |
| | Secondary | -0.06 $^{M2}$ | 3.42 $^{M1.M2}$ | 3.23 | 3.42 |
| | Tertiary | 0.43 $^{M1}$ | 3.45 $^{M1}$ | 3.24 | 3.41 |
| Mother´s schooling level | Don't know/did not answer | -0.36 $^{M2.M3.M4}$ | 3.17 | 3.16 | 3.55$^{M1.M2}$ |
| | Less than elementary | -0.64$^{M4}$ | 3.34 | 3.31 | 3.55$^{M1}$ |
| | Elementary | -0.43$^{M3}$ | 3.37 | 3.22 | 3.46 $^{M1.M2}$ |
| | Secondary | -0.09$^{M2}$ | 3.40 | 3.23 | 3.42 $^{M1. M2}$ |
| | Tertiary | 0.41$^{M1}$ | 3.43 | 3.22 | 3.41$^{M2}$ |
| Household income | Less than 2 minimum wages | -0.76$^{M5}$ | 3.35 | 3.31 | 3.57 $^{M1}$ |
| | Between 2 and 5 minimum wages | -0.35 $^{M4}$ | 3.36 | 3.22 | 3.46 $^{M1. M2}$ |
| | Between 5 and 10 minimum wages | 0.03 $^{M3}$ | 3.45 | 3.26 | 3.40 $^{M2}$ |
| | Between 10 and 20 minimum wages | 0.42 $^{M2}$ | 3.43 | 3.23 | 3.42$^{M1.M2}$ |
| | More than 20 | 0.73 $^{M1}$ | 3.41 | 3.21 | 3.40 $^{M1.M2}$ |
| Years since high school graduation | Four or more | -0.30 $^{M3}$ | 3.33 $^{M2}$ | 3.19$^{M2}$ | 3.42 $^{M1.M2}$ |
| | From two to three | 0.03 $^{M2}$ | 3.34 $^{M2}$ | 3.19$^{M2}$ | 3.39 $^{M2}$ |
| | Less than two | 0.25 $^{M1}$ | 3.52 $^{M1}$ | 3.32$^{M1}$ | 3.50 $^{M1}$ |
| Regime of the secondary school | Regular | 0.02 $^{M1}$ | 3.41 $^{M1}$ | 3.25 | 3.40 $^{M1}$ |
| | Vocational | -0.01 $^{M1}$ | 3.41 $^{M1}$ | 3.18 | 3.38 $^{M1.M2}$ |
| | Other | -0.54$^{M2}$ | 3.16$^{M2}$ | 3.13 | 3.20$^{M2}$ |
| Type of the secondary school | Private | 0.33 $^{M1}$ | 3.44 $^{M1}$ | 3.27 | 3.44 |
| | State | -0.62 $^{M2}$ | 3.29 $^{M2}$ | 3.19 | 3.45 |
| | Municipal | -0.63 $^{M2}$ | 3.41 $^{M1.M2}$ | 3.35 | 3.57 |
| | Federal | 0.31 $^{M1}$ | 3.51 $^{M1}$ | 3.18 | 3.37 |
| Domestic servant | No | -0.17 $^{M3}$ | 3.39 | 3.24 | 3.44 |
| | One | 0.49 $^{M1}$ | 3.44 | 3.24 | 3.45 |
| | Two or more | 0.28 $^{M2}$ | 3.39 | 3.25 | 3.35 |
| Fridge | No | -0.35$^{m}$ | 3.10$^{m}$ | 3.00$^{m}$ | 3.29 |
| | Yes | 0.01$^{M}$ | 3.41$^{M}$ | 3.24$^{M}$ | 3.44 |
| Car | No | -0.42$^{M3}$ | 3.36 | 3.22 | 3.45 |
| | One | -0.02$^{M2}$ | 3.40 | 3.25 | 3.44 |
| | Two or more | 0.45$^{M1}$ | 3.44 | 3.24 | 3.43 |
| Computer | No | -0.48 $^{M3}$ | 3.31 $^{M2}$ | 3.18 | 3.48 |
| | One | -0.08 $^{M2}$ | 3.41 $^{M1. M2}$ | 3.24 | 3.44 |
| | Two or more | 0.47 $^{M1}$ | 3.43 $^{M1}$ | 3.26 | 3.40 |
| Observations | | 5209 | 4992 | 4644 | 4222 |

The results for those who entered UFMG in 2012 are very similar to shown in table 2 and in the sake of brevity the results of a few selected explanatory variables are shown. The main difference is that SES seems to be more decisive in 2012 than in 2009 for GPA

differences in the first semester. Many variables that showed non-significant differences in 2009, such as race, father´s and mother´s schooling, household income, and type of secondary school, mostly showed significant results in 2012. This same tendency was observed for the comparison of students in the third semester. That is, the catching-up observed in 2009 was not observed in 2012.

Table 3 – Performance in the entrance exam in UFMG and in selected academic semesters in 2012 for different groups of students

| | | Entrance | First | Third |
|---|---|---|---|---|
| Race | Did not declare | 0.40[M1] | 3.41[M1] | 3.24 [M1] |
| | White/Asian | 0.24[M2] | 3.34[M1] | 3.21 [M1] |
| | Black/Pardo/Indigenous | -0.30[M3] | 3.13[M2] | 3.02 [M2] |
| Father´s schooling level | Don't know/did not answer | -0.46[M3] | 3.03[M3] | 2.93 [M2] |
| | Less than elementary | -0.63[M4] | 3.12[M2, M3] | 3.04 [M2] |
| | Elementary | -0.41[M3] | 3.17[M2, M3] | 3.01 [M2] |
| | Secondary | -0.06[M2] | 3.24[M2] | 3.12 [M1, M2] |
| | Tertiary | 0.54[M1] | 3.37[M1] | 3.22[M1] |
| Mother´s schooling level | Don't know/did not answer | -0.55[M3,M4] | 2.75[M4] | 2.70[M2] |
| | Less than elementary | -0.73[M4] | 3.15[M2,M3] | 3.08[M1,M2] |
| | Elementary | -0.48[M3] | 3.06[M3,M4] | 3.05[M1,M2] |
| | Secondary | -0.10[M2] | 3.23[M2] | 3.09[M2] |
| | Tertiary | 0.47[M1] | 3.36[M1] | 3.19[M1] |
| Household income | Less than 2 minimum wages | -0.81[M5] | 3.02 [M4] | 2.96 [M2] |
| | Between 2 and 5 minimum wages | -0.35[M4] | 3.17 [M3] | 3.06 [M2] |
| | Between 5 and 10 minimum wages | 0.15[M3] | 3.32 [M2] | 3.18 [M1] |
| | Between 10 and 20 minimum wages | 0.59[M2] | 3.35 [M2] | 3.23 [M1] |
| | More than 20 | 0.92[M1] | 3.49 [M1] | 3.23 [M1] |
| Type of the secondary school | Private | 0.42[M1] | 3.35[M1] | 3.19 [M1] |
| | State | -0.68[M2] | 3.08[M2] | 3.03[M2] |
| | Municipal | -0.67[M2] | 3.04[M2] | 3.00[M2] |
| | Federal | 0.53[M1] | 3.40[M1] | 3.14 [M1,M2] |
| Observations | | 5637 | 5335 | 4826 |

This result is not necessary a bad one. It depends on the distribution of the different categories by course. A more controlled analysis with econometric models will bring new insights to this point.

### 4.2 – Econometric models

This section presents the results of the econometric models. The objectives are threefold: to address the determinants of academic performance in a more controlled analysis; to analyze whether temporal trends exist; to observe whether there are differences between 2009 and 2012 due to the change in the type of the entrance exam.

Table 3 shows the results for seven models, all of them include a dummy for each course as controls. The dependent variable in the first six models is the GPA in the first semester for students who entered UFMG in 2009. Different models were estimated with the objective to observe the determinants of GPA performance with different set of explanatory variables and to verify the robustness of the results when estimated by different techniques. Last model describe the determinants of the performance in the entrance exam for those who were selected to the university. Notice that $R^2$ of this last model is much greater than the $R^2$ of model 5, both estimated by the same technique. That is, the predictive power of the

explanatory variables is much greater for the performance in the entrance exam than for the performance in GPA.

Concerning the last model, the dependent variable is the sum of all exams in the first stage of the selection process. I briefly comment the results here, as this is not the focus of the paper. Males, individuals who did not declare their race, who knew how to read foreign languages besides Spanish, who lived in higher income households, who had attended secondary regular schools, and who had attended secondary private or federal schools had higher performances. Notice that most of these results are expected, however they are biased, as the database includes those who were selected in UFMG.

The other six models describe the determinants of the GPA in the first semester for those who entered the university in 2009. Other comparisons are shown in the next tables. The first four models were estimated as double censored Tobit models. The fifth was estimated with OLS with robust and clustered errors. The sixth was estimated as double censored Tobit model in two steps.

Model 1 has only one explanatory variable besides the controls for courses. GPA in the first semester was positively correlated with the sum of the results in the first stage of the entrance exam, as expected. Model 2 divides the entrance exam results by five subjects: Portuguese, mathematics, humanities (history and geography), foreign language (English, French or Spanish) and science (physics, chemistry and biology). Notice that only three showed significant and positive correlations, the first two and the last. That is, similar to Bettinger et al. (2013), only some subjects seems to effectively predict GPA in the first semester.

Models 3 to 5 include the socioeconomic and demographic variables as controls. As observed by Leonard and Jiang (1999) and Rothstein (2004), female students had higher GPAs and lower performance in the entrance exam than males. Black/Pardo/Indigenous had worst performances in the first semester, even in a more controlled analysis. A lack of easiness in a new environment might explain this result, as models 4 and 5 control for the results in the first stage of the entrance exam. A catching-up is expected as is shown in the next table. Those who worked more than 20 hours weekly, who had not graduated in another undergraduate course, from higher income households, who had graduated from high school for more than four years and who had not attended regular or vocational schools had worst performances. Some explanations are readily available. Those who worked more than 20 hours weekly may face a shortage of time. Those who had already graduated in another undergraduate course are a positively selected sample, with more experience and possibly with positively selected unobservable traits. Those from lower income households may be catching-up their richer colleagues in the university. Those who had graduated from high school for more than four years may face a lack of habitude to do academic work. Those who had not attended regular or vocational schools attended lower quality secondary schools that have features harming the potential to do academic work not captured by the worst performance in the entrance exam. Moreover, other variables showed significant results. Students who lived in a household with a father/social father who worked in unskilled activities had a better performance, indicating a catching-up in the university. Students who had attended federal secondary schools also had a better performance. These schools have a strict selection for incoming students and those who attend these schools tend to be a positively selected sample. Students who lived in a household without a fridge had worst performances, indicating that very low SES is prejudicial for performances.

Models 2, 4, 5 and 6 differ in two aspects. Models 2, 4 and 6 differ in the set of explanatory variables included in the model. Comparing the results for the performance in the entrance exam in models 2 and 4, the main different are the significant and positive coefficients in the more controlled analysis. Model 2 shows that the predictive power of the

entrance exam is restricted to Portuguese, mathematics and science with similar magnitudes. The other two coefficients were insignificant. Model 4 shows all significant and positive coefficients after controlling for the socioeconomic and demographic variables, although humanities and foreign language coefficients are of smaller magnitude. Models 4 and 6 differ because the first included socioeconomic and demographic variables as controls and in the second the predicted value for the entrance exam was estimated based on these variables a first step of estimation and the estimated values entered in the estimation of the Tobit model in a second step. Results were quite similar, but the coefficient for humanities became non-significant in model 6. Models 4 and 5 differ in the technique used to estimate the models: the first is a double censored Tobit model and the second is an OLS model with robust and clustered errors. The results differ mostly because the humanities and foreign language coefficients became non-significant in the second model. The overall picture is that Portuguese, mathematics and science exams have a larger predictive power than the other exams. The humanities and foreign language exams are non-significant or play a smaller role in predicting GPA outcomes.

Table 4 – Performance in the first semester for students who entered UFMG in 2009

| | GPA in the first semester | | | | | | Entrance |
|---|---|---|---|---|---|---|---|
| VARIABLES | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | exam |
| Total in entrance exam | 0.0281*** | | | | | | |
| | (0.00238) | | | | | | |
| Portuguese | | 0.0477*** | | 0.0417*** | 0.0380*** | 0.0463*** | |
| | | (0.00931) | | (0.00909) | (0.0110) | (0.00930) | |
| Mathematics | | 0.0327*** | | 0.0418*** | 0.0291** | 0.0392*** | |
| | | (0.00779) | | (0.00772) | (0.0115) | (0.00788) | |
| Humanities | | 0.00630 | | 0.0114* | 0.0101 | 0.00913 | |
| | | (0.00595) | | (0.00584) | (0.00731) | (0.00596) | |
| Foreign langrage | | 0.00978 | | 0.0157** | 0.0152 | 0.0223*** | |
| | | (0.00727) | | (0.00794) | (0.0108) | (0.00773) | |
| Science | | 0.0400*** | | 0.0468*** | 0.0397*** | 0.0445*** | |
| | | (0.00448) | | (0.00448) | (0.00682) | (0.00456) | |
| Predicted for total in entrance exam | | | | | | -0.0147*** | |
| | | | | | | (0.00301) | |
| Sex: male | | | -0.219*** | -0.255*** | -0.291*** | | 1.093*** |
| | | | (0.0249) | (0.0248) | (0.0388) | | (0.137) |
| **Race** | | | | | | | |
| Did not declare | | | | | | | |
| White/Asian | | | -0.0682* | -0.0418 | -0.0445 | | -0.833*** |
| | | | (0.0396) | (0.0388) | (0.0501) | | (0.251) |
| Black/Pardo/Indigenous | | | -0.122*** | -0.0853** | -0.123*** | | -1.116*** |
| | | | (0.0415) | (0.0408) | (0.0454) | | (0.237) |
| Civil status: single | | | -0.0123 | 0.00327 | 0.0689 | | -0.0146 |
| | | | (0.0537) | (0.0528) | (0.0739) | | (0.297) |
| **Work** | | | | | | | |
| Do not work | | | | | | | |
| Up to 20 hours weekly | | | 0.0106 | 0.0205 | 0.0218 | | -0.240 |
| | | | (0.0496) | (0.0487) | (0.0762) | | (0.285) |
| More than 20 hours weekly | | | -0.0648* | -0.0716** | -0.104** | | 0.0676 |
| | | | (0.0367) | (0.0360) | (0.0447) | | (0.194) |
| Already graduated: yes | | | 0.239*** | 0.247*** | 0.0943 | | 0.261 |
| | | | (0.0541) | (0.0531) | (0.0898) | | (0.384) |
| Attended *pré-vestibular*: yes | | | -0.0239 | -0.0309 | 0.0585* | | 0.128 |
| | | | (0.0253) | (0.0249) | (0.0322) | | (0.146) |
| **Read foreign languages** | | | | | | | |
| No | | | | | | | |

| | | | | |
|---|---|---|---|---|
| Only Spanish | -0.0316 | -0.0352 | -0.0458 | 0.00323 |
| | (0.0399) | (0.0391) | (0.0495) | (0.220) |
| Another language | 0.00240 | -0.0230 | -0.0453 | 1.286*** |
| | (0.0367) | (0.0372) | (0.0487) | (0.233) |
| Two or more languages | 0.0239 | -0.00273 | -0.0216 | 1.469*** |
| | (0.0417) | (0.0421) | (0.0583) | (0.236) |
| **Father´s schooling level** | | | | |
| Don't know/did not answer | | | | |
| Less than elementary | 0.0973 | 0.0936 | 0.0951 | -0.142 |
| | (0.0780) | (0.0765) | (0.0994) | (0.382) |
| Elementary | 0.0533 | 0.0551 | 0.00173 | -0.376 |
| | (0.0801) | (0.0786) | (0.104) | (0.411) |
| Secondary | 0.132* | 0.119 | 0.132 | 0.0657 |
| | (0.0755) | (0.0741) | (0.0964) | (0.391) |
| Tertiary | 0.133* | 0.123 | 0.0639 | 0.0132 |
| | (0.0790) | (0.0775) | (0.0974) | (0.434) |
| **Mother´s schooling level** | | | | |
| Don't know/did not answer | | | | |
| Less than elementary | 0.0146 | 0.0348 | -0.0630 | -0.298 |
| | (0.123) | (0.120) | (0.131) | (0.613) |
| Elementary | 0.0616 | 0.0729 | 0.0132 | -0.290 |
| | (0.123) | (0.120) | (0.132) | (0.603) |
| Secondary | -0.0237 | -0.00791 | -0.0922 | -0.208 |
| | (0.120) | (0.118) | (0.129) | (0.583) |
| Tertiary | -0.0231 | -0.0241 | -0.147 | 0.175 |
| | (0.121) | (0.119) | (0.132) | (0.602) |
| **Household income** | | | | |
| Less than 2 minimum wages | | | | |
| Between 2 and 5 minimum wages | 0.0150 | -0.000541 | -0.0248 | 0.495** |
| | (0.0450) | (0.0442) | (0.0621) | (0.205) |
| Between 5 and 10 minimum wages | 0.00853 | -0.0151 | -0.0899 | 0.732*** |
| | (0.0511) | (0.0502) | (0.0742) | (0.247) |
| Between 10 and 20 minimum wages | -0.0642 | -0.0978* | -0.140* | 0.985*** |
| | (0.0570) | (0.0560) | (0.0801) | (0.281) |
| More than 20 | -0.165** | -0.211*** | -0.287*** | 1.495*** |
| | (0.0671) | (0.0659) | (0.100) | (0.409) |
| **Father´s occupation** | | | | |
| Owner | | | | |
| Highly skilled | 0.0802 | 0.0688 | 0.148 | 0.308 |
| | (0.0734) | (0.0719) | (0.100) | (0.440) |
| Skilled | 0.101 | 0.103 | 0.153 | -0.187 |
| | (0.0769) | (0.0753) | (0.109) | (0.490) |
| Little skilled | 0.134* | 0.129 | 0.182 | 0.0697 |
| | (0.0809) | (0.0793) | (0.120) | (0.490) |
| Unskilled | 0.161* | 0.165* | 0.118 | -0.316 |
| | (0.0910) | (0.0892) | (0.137) | (0.536) |
| Househusband | 0.0938 | 0.0698 | 0.127 | 0.579 |
| | (0.119) | (0.117) | (0.144) | (0.691) |
| Not known | 0.0328 | 0.0248 | 0.0197 | 0.0210 |
| | (0.0944) | (0.0926) | (0.129) | (0.555) |
| **Mother´s occupation** | | | | |
| Owner | | | | |
| Highly skilled | -0.0405 | -0.0317 | -0.204* | -0.455 |
| | (0.102) | (0.100) | (0.110) | (0.519) |
| Skilled | 0.0104 | 0.0194 | -0.0861 | -0.461 |
| | (0.102) | (0.100) | (0.116) | (0.549) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Little skilled | | | -0.0326 | -0.0257 | -0.216* | | -0.474 |
| | | | (0.107) | (0.105) | (0.122) | | (0.611) |
| Unskilled | | | -0.0750 | -0.0667 | -0.144 | | -0.665 |
| | | | (0.113) | (0.111) | (0.136) | | (0.623) |
| Housewife | | | 0.0334 | 0.0378 | -0.124 | | -0.421 |
| | | | (0.103) | (0.101) | (0.117) | | (0.547) |
| Not known | | | 0.0235 | 0.0359 | -0.0807 | | -0.498 |
| | | | (0.129) | (0.127) | (0.129) | | (0.740) |
| **Years since high school graduation** | | | | | | | |
| Four or more | | | | | | | |
| From two to three | | | 0.0415 | 0.0542* | 0.147*** | | -0.503** |
| | | | (0.0325) | (0.0319) | (0.0396) | | (0.211) |
| Less than two | | | 0.171*** | 0.177*** | 0.316*** | | -0.233 |
| | | | (0.0366) | (0.0359) | (0.0494) | | (0.236) |
| **Type of regime** | | | | | | | |
| Regular | | | | | | | |
| Vocational | | | -0.00339 | 0.0292 | -0.0313 | | -0.786*** |
| | | | (0.0433) | (0.0425) | (0.0556) | | (0.256) |
| Other | | | -0.209*** | -0.170** | -0.222** | | -0.857* |
| | | | (0.0697) | (0.0684) | (0.104) | | (0.445) |
| **Type of secondary school** | | | | | | | |
| Private | | | | | | | |
| State | | | -0.101*** | -0.00355 | -0.00585 | | -2.727*** |
| | | | (0.0334) | (0.0335) | (0.0384) | | (0.188) |
| Municipal | | | -0.0293 | 0.0690 | 0.0672 | | -2.630*** |
| | | | (0.0572) | (0.0566) | (0.0646) | | (0.328) |
| Federal | | | 0.131*** | 0.149*** | 0.151** | | -0.476 |
| | | | (0.0468) | (0.0460) | (0.0592) | | (0.297) |
| **Domestic servant** | | | | | | | |
| No | | | | | | | |
| One | | | -0.0341 | -0.0253 | -0.0385 | | -0.206 |
| | | | (0.0325) | (0.0319) | (0.0366) | | (0.166) |
| Two or more | | | -0.0649 | -0.0466 | -0.0512 | | -0.351 |
| | | | (0.0587) | (0.0575) | (0.0760) | | (0.299) |
| **Fridge: yes** | | | 0.198** | 0.180** | 0.285** | | 0.870* |
| | | | (0.0918) | (0.0900) | (0.118) | | (0.516) |
| **Car** | | | | | | | |
| No | | | | | | | |
| One | | | 0.00372 | 0.00776 | 0.0550 | | -0.143 |
| | | | (0.0304) | (0.0299) | (0.0378) | | (0.176) |
| Two or more | | | 0.0551 | 0.0468 | 0.0767 | | 0.159 |
| | | | (0.0390) | (0.0382) | (0.0489) | | (0.219) |
| **Computer** | | | | | | | |
| No | | | | | | | |
| One | | | 0.0394 | 0.0513 | 0.0211 | | -0.235 |
| | | | (0.0382) | (0.0375) | (0.0440) | | (0.222) |
| Two or more | | | 0.0353 | 0.0328 | -0.00272 | | 0.140 |
| | | | (0.0470) | (0.0461) | (0.0590) | | (0.256) |
| Constant | 1.817*** | 1.851*** | 2.729*** | 1.371*** | 1.578*** | 2.288*** | 41.79*** |
| | (0.157) | (0.161) | (0.221) | (0.243) | (0.284) | (0.184) | (0.966) |
| Observations | 4,992 | 4,992 | 4,985 | 4,985 | 5,200 | 4,985 | 4,985 |
| (Pseudo) R-squared | 0.166 | 0.168 | 0.179 | 0.194 | 0.348 | 0.170 | 0.745 |

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Controls for courses and place of residence before attending the university

The next analysis has two main objectives: to observe time trends in selected variables and to compare the results between 2009 and 2012, as the first stage in the entrance exam changed from the UFMG´s own exam to the ENEM. Table 5 presents five models all with the same set of explanatory variables and estimated as a Tobit model. The variables Portuguese and foreign language were grouped in the 2009 data in order to make comparison with 2012 more insightful, as the ENEM has only four exams instead of the five mentioned in table 3. Notice that the pseud $R^2$ decrease with time in the university. That is, the predictive power of the explanatory variables decrease as the student develops through the university.

The presentation begins with the time trends of the selected socioeconomic and demographic variables. Males had worst performances in all models. Blacks/pardos/indigenous had a worst performance only in the first semester for those who entered UFMG in 2009. That is, the slight difference was wiped during the university. Those who worked more than 20 hours weekly showed a catching-up with those who did not work. Those who worked up to 20 hours showed a better performance after a time in the university for those who entered UFMG in 2009.

Concerning SES, taking together the father's and the mother´s schooling level, that tend to be highly correlated, no clear time trend is observed. Most income coefficients were non-significant, as were the coefficients for domestic servant. However, two variables related to SES showed a trend. First, those who did not had a fridge at home, mostly poor individuals, showed a catching-up with the other students. Those who had two or more cars in the household showed a better performance in later semesters, suggesting a better use of time, but results were significant only for 2009.

Those who had finished high school four years or more before entering the university and those who had not attended regular or vocational schools showed lower performances in most or all models, with no clear catching-up trend. Concerning the type of secondary school, those who had attended secondary federal schools tend to lose their initial advantage and those from municipal or state schools tend to acquire some positive aspects affecting their performances, both trends representing a homogenization of results

There was a change in the first stage of student's selection process from 2009 to 2012, from UFMG´s own exam to the use of ENEM. One main difference was observed. The parent´s education seems to matter for the ENEM, as the coefficients for the mother´s or the father´s education were positive and significant only for the data in 2012. However, no clear trend was observed, reflecting mostly greater differences in performance for those who do not know the level of education of their mother and/or father when comparing to others that knew the level of their parent's schooling, possibly because the first live in uniparental households.

Table 5 – Performance in the different semesters for students that entered UFMG in 2009 or in 2012

| | 2009 | | | 2012 | |
|---|---|---|---|---|---|
| VARIABLES | 1ª semester | 3ª semester | 6ª semester | 1ª semester | 3ª semester |
| Language | 0.0271*** | 0.0342*** | 0.0226*** | 0.00103*** | 0.00155*** |
| | (0.00576) | (0.00669) | (0.00752) | (0.000330) | (0.000395) |
| Mathematics | 0.0421*** | 0.0229** | 0.0243** | 0.000548*** | 0.000734*** |
| | (0.00772) | (0.00904) | (0.0101) | (0.000188) | (0.000225) |
| Humanities | 0.0122** | 0.00417 | 0.00270 | 0.00167*** | 0.00195*** |
| | (0.00583) | (0.00683) | (0.00764) | (0.000311) | (0.000367) |
| Science | 0.0470*** | 0.0428*** | 0.0244*** | 0.00285*** | 0.00256*** |
| | (0.00448) | (0.00526) | (0.00589) | (0.000281) | (0.000327) |
| Sex: male | -0.258*** | -0.225*** | -0.290*** | -0.245*** | -0.285*** |
| | (0.0248) | (0.0289) | (0.0323) | (0.0256) | (0.0301) |
| **Race** | | | | | |
| Did not declare | | | | | |
| White/Asian | -0.0415 | -0.00268 | 0.0546 | 0.00698 | 0.0479 |

| | | | | | |
|---|---|---|---|---|---|
| | (0.0389) | (0.0455) | (0.0523) | (0.0434) | (0.0517) |
| Black/Pardo/ | -0.0830** | -0.0501 | -0.0368 | -0.0528 | -0.0145 |
| Indigenous | (0.0408) | (0.0475) | (0.0546) | (0.0448) | (0.0535) |
| **Work** | | | | | |
| Do not work | | | | | |
| Up to 20 hours | 0.0182 | 0.150** | 0.170*** | -0.0188 | -0.00603 |
| weekly | (0.0487) | (0.0582) | (0.0656) | (0.0468) | (0.0558) |
| More than 20 hours | -0.0695* | 0.0205 | -0.0359 | -0.0208 | 0.00672 |
| weekly | (0.0360) | (0.0420) | (0.0473) | (0.0367) | (0.0439) |
| **Father´s schooling level** | | | | | |
| Don't know/did not answer | | | | | |
| Less than elementary | 0.0960 | 0.162* | 0.110 | 0.0982 | 0.196** |
| | (0.0766) | (0.0901) | (0.102) | (0.0700) | (0.0822) |
| Elementary | 0.0582 | 0.137 | 0.0536 | 0.0815 | 0.157* |
| | (0.0786) | (0.0927) | (0.105) | (0.0726) | (0.0854) |
| Secondary | 0.121 | 0.104 | 0.0248 | 0.0138 | 0.207*** |
| | (0.0741) | (0.0876) | (0.0986) | (0.0680) | (0.0799) |
| Tertiary | 0.123 | 0.0964 | 0.0173 | 0.0117 | 0.201** |
| | (0.0775) | (0.0917) | (0.103) | (0.0720) | (0.0845) |
| **Mother´s schooling level** | | | | | |
| Don't know/did not answer | | | | | |
| Less than elementary | 0.0334 | -0.111 | -0.134 | 0.237** | 0.190 |
| | (0.120) | (0.139) | (0.159) | (0.115) | (0.139) |
| Elementary | 0.0734 | -0.181 | -0.147 | 0.147 | 0.155 |
| | (0.120) | (0.139) | (0.159) | (0.116) | (0.140) |
| Secondary | -0.00918 | -0.209 | -0.185 | 0.201* | 0.108 |
| | (0.118) | (0.136) | (0.156) | (0.113) | (0.136) |
| Tertiary | -0.0253 | -0.210 | -0.188 | 0.204* | 0.103 |
| | (0.119) | (0.138) | (0.158) | (0.115) | (0.140) |
| **Household income** | | | | | |
| Less than 2 minimum wages | | | | | |
| Between 2 and 5 minimum wages | -0.00138 | -0.00789 | 0.0242 | 0.0281 | -0.0106 |
| | (0.0442) | (0.0515) | (0.0580) | (0.0387) | (0.0460) |
| Between 5 and 10 minimum wages | -0.0174 | -0.0573 | -0.0663 | 0.00525 | 0.0133 |
| | (0.0502) | (0.0585) | (0.0657) | (0.0465) | (0.0557) |
| Between 10 and 20 minimum wages | -0.100* | -0.115* | -0.0601 | -0.0335 | -0.0431 |
| | (0.0560) | (0.0654) | (0.0738) | (0.0542) | (0.0648) |
| More than 20 | -0.215*** | -0.219*** | -0.108 | 0.0429 | -0.128 |
| | (0.0660) | (0.0770) | (0.0868) | (0.0669) | (0.0797) |
| **Years since high school graduation** | | | | | |
| Four or more | | | | | |
| From two to three | 0.0562* | 0.122*** | 0.110*** | 0.102** | 0.0134 |
| | (0.0319) | (0.0371) | (0.0414) | (0.0414) | (0.0492) |
| Less than two | 0.179*** | 0.268*** | 0.256*** | 0.122*** | 0.163*** |
| | (0.0359) | (0.0420) | (0.0473) | (0.0378) | (0.0452) |
| **Type of regime** | | | | | |
| Regular | | | | | |
| Vocational | 0.0289 | 0.0882* | 0.0502 | 0.174*** | 0.155*** |
| | (0.0425) | (0.0499) | (0.0555) | (0.0452) | (0.0536) |
| Other | -0.170** | -0.283*** | -0.374*** | -0.236*** | -0.354*** |
| | (0.0684) | (0.0833) | (0.0963) | (0.0673) | (0.0841) |

| | | | | | |
|---|---|---|---|---|---|
| **Type of secondary school** | | | | | |
| Private | | | | | |
| State | -0.00233 | -0.0337 | 0.0169 | 0.0806** | 0.172*** |
| | (0.0335) | (0.0392) | (0.0437) | (0.0348) | (0.0415) |
| Municipal | 0.0722 | 0.106 | 0.136* | -0.0724 | 0.104 |
| | (0.0566) | (0.0656) | (0.0731) | (0.0567) | (0.0675) |
| Federal | 0.147*** | 0.0328 | 0.0621 | 0.0669 | 0.0323 |
| | (0.0460) | (0.0538) | (0.0594) | (0.0506) | (0.0594) |
| **Domestic servant** | | | | | |
| No | | | | | |
| One | -0.0262 | -0.0115 | 0.0464 | -0.00765 | -0.0175 |
| | (0.0319) | (0.0374) | (0.0419) | (0.0352) | (0.0417) |
| Two or more | -0.0472 | -0.0106 | -0.0450 | -0.118* | 0.0414 |
| | (0.0576) | (0.0663) | (0.0740) | (0.0679) | (0.0824) |
| **Fridge: yes** | 0.175* | 0.0680 | 0.0890 | 0.169* | -0.0152 |
| | (0.0900) | (0.108) | (0.120) | (0.0947) | (0.117) |
| **Car** | | | | | |
| No | | | | | |
| One | 0.00638 | 0.0368 | 0.0592 | 0.0139 | 0.0254 |
| | (0.0299) | (0.0347) | (0.0388) | (0.0304) | (0.0358) |
| Two or more | 0.0460 | 0.0843* | 0.139*** | 0.0458 | 0.0235 |
| | (0.0382) | (0.0443) | (0.0495) | (0.0388) | (0.0455) |
| **Computer** | | | | | |
| No | | | | | |
| One | 0.0522 | 0.0727* | -0.0123 | 0.0823** | 0.0437 |
| | (0.0375) | (0.0432) | (0.0486) | (0.0412) | (0.0490) |
| Two or more | 0.0322 | 0.0876 | -0.0303 | 0.111** | 0.0542 |
| | (0.0461) | (0.0534) | (0.0603) | (0.0468) | (0.0557) |
| Constant | 1.388*** | 1.935*** | 2.076*** | -1.362*** | -1.606*** |
| | (0.243) | (0.289) | (0.333) | (0.337) | (0.404) |
| Observations | 4,985 | 4,641 | 4,216 | 5,326 | 4,820 |
| Pseudo R-squared | 0.194 | 0.156 | 0.125 | 0.199 | 0.137 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Controls for courses, place of residence before attending the university, father´s and mother's occupation, previous knowledge of reading in foreign language, civil status, those who had already graduated and who had attend a *pré-vestibular*.

The last two analyses include the results of the second stage of the selection process. As described in the methodology, seven groups of courses were created: medicine; language and linguistics; general engineering, physics, chemistry and geology; architecture, computers science, statistics and mathematics; business, accounting, economics and information science; agricultural and husbandry sciences, health sciences, biology and dentistry; and social sciences, law and teaching.

Tables 6 and 7 show the results for GPAs in the first semester for the groups of courses, respectively for those who entered UFMG in 2009 and in 2012. The upper panels show the Tobit models with only courses as controls. The objective is to observe which exam in the first and second stage had a significant predictive power. The bottom panel shows the goodness of fit for models that includes different sets of controls. The objective is to observe the predictive power of sets of controls, similarly as done by Rothstein (2004).

For medicine (group 1), none of the variables were significant for those who entered UFMG in 2009. That is, none of the exams in the first or second stage had a significant predictive power on first semester GPAs. For the 2012 data, the ENEM´s exams of

humanities and science showed positive and significant coefficients. Moreover, the exam of biochemistry in the second stage also showed a positive and significant coefficient. These results suggest that the use of ENEM have a greater predictive power than the use of UFMG´s own exam. Besides, the second stage of UFMG´s exam became significant with the use of ENEM.

Concerning the predictive power of sets of controls, shown in the bottom panel, the UFMG´s exam in 2009 showed a very small pseudo $R^2$ of 0.008. The explanatory variables used as controls had a much larger predictive power, as $R^2$ increased to 0.136. The results for 2012 show that the first stage had a much greater explanatory power than the observed in 2009, 0.030, but still most of the predictive power was due to the controls.

For language and linguistics (group 2), the coefficients in the second stage for composition and Portuguese in both years and for history in 2012 were positive and significant. Language, humanities and science in the first stage showed non-significant predictive power. Moreover, the coefficient for mathematics of the first stage was positive and significant in both models, suggesting that this last exam captures features that are not represented in the second stage.

The predictive power of the entrance exams in 2009 and 2012 were much larger than previously observed for medicine. The magnitudes of the predictive power of both stages were reasonable close to the observed for the predictive power of the controls.

For group 3, general engineering, physics, chemistry and geology, most coefficients in the second stage were significant, including composition. Conversely, only one coefficient of the first stage was significant, which was language in 2009. That is, the second stage apparently had most of the predictive power of the entrance exam, what was observed especially for 2009 in the bottom panel. Notice that the predictive powers of the exams net of the predictive power of the courses are similar to the observed for the controls.

The fourth group is composed of architecture, computers science, statistics and mathematics. For the second stage, both coefficients for mathematics and one for physics were significant, but none for composition. For the first stage, only coefficients of mathematics and science were significant, while for language and humanities they were not significant. For this group, the predictive power of the controls seems to be greater, although the predictive powers of the exams are not negligible.

For business, accounting, economics and information science (group 5), regarding the second stage, all coefficients for composition were non-significant, while all for mathematics, one for geography and one for history were significant. In the first stage, all coefficients in 2009 were non-significant. In 2012, humanities show a negative coefficient, what was not anticipated, and science, a positive. Similarly to the previous group, the predictive power of the controls for this group seems to be greater, although the predictive power of the exams are not minor.

For agricultural and husbandry sciences, health sciences, biology and dentistry (group 6), for the first stage, the coefficients for science were significant in both models and humanities in 2012. In 2009 only chemistry showed a significant coefficient in the second stage. When the ENEM was used as first stage, all the coefficients in the second were significant. This suggests that the use of ENEM as first stage increased the predictive power of the use of UFMG´s exam in the second stage. For this group, the predictive power of exams and controls are quite similar.

Finally, for social sciences, law and teaching (group 7), the first stage show mostly non-significant coefficients and one negative and significant one that is for mathematics in 2012. That is, apparently the first stage has a very small predictive power, as also observed in the bottom panel. The composition and history coefficients of the second stage were significant in both models, while geography showed non-significant coefficients. However,

the predictive power of the second stage is small. That is, most of the predictive power is due to controls.

Overall, one out of fourteen coefficients was significant for language. The ENEM exam for language showed only non-significant results. Correlations between language in the first stage and the other exams in the first and second are much stronger with the ENEM exam, and this might explain part of this results. For mathematics in the first stage, four coefficients were significant, but one was negative, contrary to expectations. Two of the positive and significant coefficients were for the language and linguistics group that does not have mathematics in the second stage. That is, besides this group, the predictive power of mathematics in the first stage is close to non-significant. All the coefficients for humanities in the first stage in UFMG´s own exam were non-significant and two coefficients for the ENEM were positive and significant, while one was negative. That is, the predictive power of this exam is also small. Five of the coefficients for science were significant, although the results of this exam are highly correlated with math, physics, chemistry and biology in the second stage. Taking together the four exams, only science seems to have a reasonable predictive power when a second stage in included as exam. Comparing the results of the bottom panel for courses and course and first stage, the predictive power of the ENEM´s first stage is much larger that the observed for UFMG´s own exam.

Notice that the coefficients for composition were significant in seven models, including both models for groups 2, 3 and 7. Correlations with other exams are much smaller than the observed for other variables. Is this because other features are tested or because evaluations are noisier for composition? All coefficients for mathematics, Portuguese and chemistry in the second stage are significant. For physics, biology, history, geography and biochemistry, most coefficients were non-significant in 2009 and most were significant in 2012, although correlation with the exams in the first stage are much higher for the second. Comparing the results of the bottom panel for courses and first stage with courses, first and second stages, the predictive power of the second stage are similar in both years

Comparing the results of the bottom panel for courses, courses and first and second stage and courses, first and second sage and controls, the predictive power of the UFMG´s own exam in two stages had a predictive power smaller than the controls, while results for ENEM´s first stage and UFMG´s second stage were similar to the observed for controls.

Table 6 – Performance in the first semester for students that entered UFMG in 2009 in different group of course

| | Groups | | | | | | |
|---|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | First stage | | | | |
| Language | 0.00792 | -0.00350 | 0.0278* | -0.000456 | 0.0240 | 0.0121 | 0.00865 |
| | (0.0237) | (0.0219) | (0.0146) | (0.0254) | (0.0277) | (0.0103) | (0.0106) |
| Mathematics | 0.00309 | 0.0836** | 0.0149 | 0.0477 | -0.00763 | -0.0170 | -0.00892 |
| | (0.0271) | (0.0341) | (0.0205) | (0.0389) | (0.0350) | (0.0140) | (0.0146) |
| Humanities | -0.0250 | -0.0138 | 0.00686 | -0.0313 | 0.0234 | 0.0145 | -0.0119 |
| | (0.0251) | (0.0242) | (0.0155) | (0.0268) | (0.0294) | (0.0107) | (0.0114) |
| Science | 0.0161 | 0.0154 | 0.0208 | 0.0563** | 0.0277 | 0.0158* | -0.00238 |
| | (0.0234) | (0.0185) | (0.0131) | (0.0223) | (0.0198) | (0.00887) | (0.00850) |
| | | | Second stage | | | | |
| Composition | -0.00597 | 0.0234*** | 0.00746** | 0.00409 | -0.00398 | 0.00343 | 0.00542** |
| | (0.00601) | (0.00514) | (0.00324) | (0.00527) | (0.00531) | (0.00224) | (0.00238) |
| Mathematics | | | 0.0141*** | 0.0115** | 0.0208*** | | |
| | | | (0.00228) | (0.00444) | (0.00383) | | |
| Portuguese | | 0.00647** | | | | | |
| | | (0.00311) | | | | | |
| Physics | | | 0.00287 | 0.00501 | | | |
| | | | (0.00213) | (0.00436) | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Chemistry | | | 0.0155*** | | | 0.0126*** | |
| | | | (0.00326) | | | (0.00180) | |
| Biology | | | | | | 0.00114 | |
| | | | | | | (0.00187) | |
| Geography | | | | | 0.00913** | | 0.00307 |
| | | | | | (0.00403) | | (0.00231) |
| History | | 0.00362 | | | -0.00770 | | 0.00360** |
| | | (0.00310) | | | (0.00586) | | (0.00177) |
| Biochemistry | 0.00623 | | | | | | |
| | (0.00497) | | | | | | |
| Observations | 302 | 327 | 1,028 | 334 | 262 | 1,063 | 886 |
| | | | | Goodness of fit | | | |
| Courses | 0.0000 | 0.008 | 0.083 | 0.137 | 0.076 | 0.178 | 0.180 |
| Courses and first stage | 0.004 | 0.026 | 0.098 | 0.165 | 0.102 | 0.196 | 0.183 |
| Courses, first and second stage | 0.008 | 0.061 | 0.131 | 0.176 | 0.146 | 0.216 | 0.191 |
| Courses, first and second stage, and all controls | 0.136 | 0.163 | 0.189 | 0.256 | 0.247 | 0.268 | 0.236 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Controls for courses, place of residence before attending the university, father´s and mother's occupation, previous knowledge of reading in foreign language, civil status, those who had already graduated and who had attend a *pré-vestibular*, SES levels, high school variables, working load, race and sex.

Table 7 – Performance in the first semester for students that entered UFMG in 2012 in different group of course

| | | | | Groups | | | |
|---|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | First stage | | | |
| Language | 0.00190 | 0.000635 | 0.00119 | 0.00161 | 0.00125 | -0.000539 | 0.00107 |
| | (0.00152) | (0.00130) | (0.000810) | (0.00149) | (0.00130) | (0.000644) | (0.000681) |
| Mathematics | 0.000959 | 0.00142** | 0.000947 | 0.00257** | -0.00152 | -8.35e-05 | -0.000814** |
| | (0.00122) | (0.000581) | (0.000586) | (0.00110) | (0.000924) | (0.000342) | (0.000347) |
| Humanities | 0.00300** | -1.58e-05 | 0.000572 | 0.000221 | -0.00218* | 0.00103* | 0.000509 |
| | (0.00127) | (0.00132) | (0.000774) | (0.00146) | (0.00130) | (0.000603) | (0.000705) |
| Science | 0.00272** | -0.000935 | 0.00124 | 0.000434 | 0.00479*** | 0.00190*** | 0.000854 |
| | (0.00135) | (0.00104) | (0.000761) | (0.00138) | (0.00118) | (0.000566) | (0.000564) |
| | | | | Second stage | | | |
| Composition | -0.0180 | 0.0417* | 0.0389*** | -0.000543 | 0.0134 | 0.0181* | 0.0393*** |
| | (0.0283) | (0.0216) | (0.0142) | (0.0277) | (0.0221) | (0.0106) | (0.0120) |
| Mathematics | | | 0.00648*** | 0.00983** | 0.00897** | | |
| | | | (0.00236) | (0.00464) | (0.00365) | | |
| Portuguese | | 0.0196*** | | | | | |
| | | (0.00446) | | | | | |
| Physics | | | 0.0168*** | 0.00980** | | | |
| | | | (0.00253) | (0.00486) | | | |
| Chemistry | | | 0.0167*** | | | 0.0108*** | |
| | | | (0.00331) | | | (0.00242) | |
| Biology | | | | | | 0.00617** | |
| | | | | | | (0.00284) | |
| Geography | | | | | 0.00344 | | 0.00187 |
| | | | | | (0.00615) | | (0.00330) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| History | | 0.0128** (0.00519) | | | 0.0169*** (0.00563) | | 0.0112*** (0.00303) |
| Biochemistry | 0.0145* (0.00804) | | | | | | |
| Observations | 236 | 316 | 1,063 | 306 | 314 | 1,254 | 1,011 |
| | | | | Goodness of fit | | | |
| Courses | 0 | 0.109 | 0.056 | 0.198 | 0.110 | 0.150 | 0.102 |
| Courses and first stage | 0.030 | 0.183 | 0.086 | 0.228 | 0.149 | 0.173 | 0.115 |
| Courses, first and second stage | 0.037 | 0.227 | 0.120 | 0.237 | 0.168 | 0.182 | 0.126 |
| Courses, first and second stage, and all controls | 0.152 | 0.287 | 0.171 | 0.305 | 0.278 | 0.219 | 0.165 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Controls for courses, place of residence before attending the university, father´s and mother's occupation, previous knowledge of reading in foreign language, civil status, those who had already graduated and who had attend a *pré-vestibular*, SES levels, high school variables, working load, race and sex.

## 5 – Conclusion

There were many recent changes in the selection process of higher education institutions in Brazil. In particular concerning the UFMG, it was implemented a bonus policy in the entrance exam of 2009, which remained valid until 2012. In 2012 it was approved the law of quotas that was implemented in all federal higher education institutions in Brazil (Telles and Paixão, 2013). The Reuni policy was also implemented in UFMG and in other public universities, remarkably increasing the number of slots in public federal universities in Brazil between 2008 and 2012. Moreover, until recently, most universities had their own exams and, in the last years, the ENEM began to be used as part or as the unique exam of tertiary education student's selection (Lima and Machado, 2016).

All these police changes may have influenced several aspects related to public higher education in Brazil, in particular associations between performances in the entrance exams and posterior academic performance in the university. The main objective of this paper was to analyze these associations in UFMG between the years of 2009 and 2012.

Some of the main results are summarized below. Differences between population groups in the entrance exams tend to be more significant than for GPAs. Besides, differences in the first semester tend to be greater than in the third semester, which tend to be larger than in the sixth. Both results clearly indicate a catching-up of many groups in the population while in the university.

For the UFMG´s own first stage for those who entered this institution in 2009, Portuguese, mathematics and science exams had a larger predictive power than the other exams. The humanities and foreign language exams showed non-significant results or played smaller roles in predicting GPA outcomes. For those who were approved in the entrance exam of 2012, when the ENEM was used as a first stage of the selection process, all four exams (language, mathematics, humanities and science) showed positive and significant results. When both stages were analyzed conjointly regarding the significance of the predictive power, language, mathematics and humanities in the first stage had mostly non-significant coefficients in both years, while most coefficients for science were significant. That is, the first stage has a reasonable predictive power when the results of the second stage are not included in the models.

For the second stage, the coefficients for composition were significant basically for courses, such as: language and linguistics; general engineering, physics, chemistry and geology; and social sciences, law and teaching. For other courses, the results were mostly non-significant, indicating specificity of the predictive power of the exam. All coefficients for mathematics, Portuguese and chemistry in the second stage were significant. For physics, biology, history, geography and biochemistry, most coefficients were non-significant in 2009 and most were significant in 2012. These results suggest that the second stage of UFMG´s exam had a greater predictive power when ENEM w used as the first stage of the selection process.

Among the four subjects of the ACT, mathematics, English, reading, and science, Bettinger et al. (2013) proposed that the selection process should include only the first two. Based on the empirical results of the present paper, could I propose something similar? Not really. Nowadays the ENEM is the basically the unique exam used to select students in federal universities in Brazil. All the four exams had significant and positive coefficients in the models with only these exams in the first stage for those who entered UFMG in 2012, indicating a significant predictive power of all exams.

Rothstein (2004) proposed that information other than the SAT scores should be used in the student's selection. Based on the empirical results above, could I propose something similar? Given that controls have a significant predictive power and that a catching-up occurs in the university, affirmative action policies based on socioeconomic and demographic variables, as those implemented by the quota system, may not harm overall performance in the university if well designed. Thus, periodical analysis about this topic should be performed to evaluate such policies.

Finally, the results of the second stage were mostly significant when the ENEM is used as first stage. Thus, the implementation of an ENEM´s second stage, similar to the UFMG´s own exam, would be a good choice to better select students, increasing academic performance, while inducing changes in the secondary level, in particular regarding the depth and coverage of the subjects lectured.

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