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Abstract

This paper investigates the determinants of academic achievements of post-reform undergraduate students of Ca' Foscari University of Venice. Academic achievements are measured with the students' grade point averages and time to graduation. The set of independent variables contains information on students' personal characteristics, prior academic achievements, family background, academic track at university, and several "peer-group" effects. The novelty of this paper is threefold: i) we use a rich data set obtained by matching the University's administrative data records with the data drawn from the AlmaLaurea questionnaires, ii) we pay particular attention to the effects of academic track regularity on students' performance, and iii) we propose a theoretical model of a trade-off between grades and time to graduation, and test empirically its validity by taking into account the problem of reciprocal causation between grades and time to graduation. The model suggests that grades and time to graduation are inversely related. While there is an unambiguous effect of students' ability and financial condition on grades, these effects are less straightforward in the case of time to graduation. The sign and the magnitude of the effects of ability and financial condition on time to graduation depends on students' academic track regularity. Moreover, the relative importance of grades and time to graduation depends, in addition to ability and financial situation, also on the external economic conditions in the labor market. Our empirical exercise confirms the predictions of the model.

JEL-Code: I210, I230, D910.

Keywords: academic achievements, academic track regularity, trade-off between grades and time to degree, endogeneity, simultaneous equations.

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1 Introduction

This paper intends to analyze the determinants of the production of academic achievements for undergraduate students of Ca' Foscari University of Venice. There is a substantial literature that investigates academic performance both in terms of grades and excess time to graduation. For instance, Cappellari (2012) and Checchi and Flabbi (2005) find a positive association between parental education and high school final grades, and time employed to graduate. Cappellari, Lucifora and Pozzoli (2012) investigate the factors influencing the grades in mathematics achieved by first year students in Economics, and find that the high school grade and the type of high school attended are significantly associated with math grades. Boero, Laureti and Naylor (2005), on the other hand, show that the excess time to graduation is negatively correlated with the individual characteristics, parental background and family income. Similarly, Checchi et al. (2000) show that students from wealthier families graduate faster because of stronger networking and better prospects in the labor market. Brunello and Winter-Ebmer (2003) conduct a cross-country analysis at the European level and show that later completion can be due to exogenous events after enrollment such as labor market conditions. They find that the excess time to graduation is higher the higher is the country's unemployment rate for college graduates and the lower is the country - specific wage gap. Moreover, they find a positive relationship between unemployment protection and the share of public expenditure for tertiary education in total expenditure and time to degree. Messer and Wolter (2010) confirm the relevance of economic conditions for later completion and support the thesis that delay to graduation may increase with unemployment and high real interest rates. Aina et al. (2011) find that the elapsed time to degree depends not only of students' ability, effort and working experiences but also on the external conditions in the labor market. Regarding the level of tuition fees, Bound, Lovenheim and Turner (2012) stress that a reduction in public resources devoted to universities and the consequent increase in the tuition fees, is associated with longer time to degree in the US. The negative effect of rising tuition fees is found also in Hakkinen and Uusitalo (2003) while Garibaldi et al. (2007) claim that increasing the level of tuition fees during the last legal

academic year increases the probability of graduating in time. On the other side, there is a lack of consensus about the importance of teachers and their quality, salary levels and experience as well as of administrative supports, facilities and other "school quality inputs" (Hanushek, 2006; Todd and Wolpin, 2003). However, Aina et al. (2011) consider a large number of Italian universities and find that university's characteristics in terms of human and physical resources provided to students affect their study duration. Light and Strayer (2000) stress the important effect of students' ability on grades and time to degree, but also claim that higher delay to graduation in lower quality colleges is due to a selection problem since low quality universities lack high ability students and financial support.

Cappellari (2012), Checchi (2000), Bertola and Checchi (2002), and Bertola, Checchi and Oppedisano (2007) analyze the relationship between the type of high school attended and academic achievements and find that general high schools improve academic performance and that private high schools are associated with less satisfactory academic achievements. Checchi and Zollino (2001), in addition to the negative impact of private schools, confirm a strong association of the average grade with the type of high school attended. Moreover, they find a significant impact of peer's level of economic conditions on individuals' academic performance. Similarly, Brunello, De Paola and Scoppa (2010) find a positive and statistically significant peer effects for students enrolled in engineering, math and natural sciences, and close to zero or negative in the humanities and social sciences. Regarding the potential differences in academic achievements between male and female peers, McNabb, Sarmistha and Sloane (2002) and Aina (2010) find that the probability of obtaining a higher leaving grade is greater for females than for males. Similar evidence is found in Cappellari, Lucifora and Pozzoli (2012).

This paper is concerned with the determinants of academic achievements of "*post-reform*" undergraduate students of Ca' Foscari University of Venice. We consider two main indicators of academic performance, namely the students' grade point averages and the "On-Track/Out-of-Track" status. In addition, we also consider the students' final grade at graduation and the time employed to graduate expressed in years. In order to obtain the largest possible set

of information we match the University's administrative data records with the data drawn from the *AlmaLaurea* questionnaires compiled by students the day before their graduation.

We pay particular attention to the role of students' behavior regarding the fulfillment of didactic requirements such as the class attendance, the number of *CFU* credits earned during the first and the second academic year, the average number of *CFU* credits *per* year, and the number of passed exams for each academic year. Controlling for the average number of *CFU* credits *per* exam during the first and the second academic year, we are able to assess the importance of timing (or sequence) of passing the scheduled exams in the sense that students which take "bigger" exams or larger blocks of credits at the beginning of their academic career may perform differently with respect to those who decide to resit the bigger exams a year later. The data on students' academic performance are obtained from the University's administrative records which are then matched with the data contained in the *AlmaLaurea* questionnaires. In such a way we were able to associate to each student a large set of information regarding their family backgrounds, prior academic achievements, academic experience, part and/or full-time working during the studies, and participation in internships and international exchange programs, as well as the duration of such experiences.

The second important issue addressed in this paper relates to the endogeneity of grades and time to graduation. Since students can freely choose the number of semesters and the objective in terms of grades they want to reach, the two indicators of academic performance cannot be treated as independent. In other words, they may simultaneously determine each other. We propose a simple theoretical model of a trade-off between grades and duration and we show that in general grades and time to graduation are inversely related. While there is an unambiguous effect of students' ability and financial condition on grades, these effects are less straightforward in the case of time to graduation. The sign and the magnitude of the effects of ability and financial condition on time to graduation depends on students' academic track regularity. As long as a student regularly attends classes and other didactic activities, the level of income may facilitate his or her university career in the sense that wealthier students have less need for additional earnings in order to maintain themselves.

These students, hence, graduate faster. Moreover, for any given level of income and ability, an increase in time spent on working or other extra-curricular activities decreases both grades and time savings.

Our empirical strategy consists of two parts. We first estimate the factors influencing grades and duration separately. In other words, we implicitly assume that they are independent. Given the characteristics of our dependent variables (limited or truncated) we check for the presence of the *out-of-range* predictions produced by the standard *OLS* procedure and, where it is the case, we apply the *truncated estimation method*. We classify students into two different categories according to their academic career duration, namely those who graduate within the legal period ("On-Track") and those who graduate above the minimum legal period ("Out-of-Track"). The probability of being "On-Track" is then estimated using the *Probit* model. In the second part of the analysis we test the predictions of our theoretical model. Since grades and duration may simultaneously determine each other, the standard estimation methods would result in biased and inconsistent estimates. We instrument grades and duration with several individual - specific and macroeconomic variables and we include them together with other regressors in their respective equations. In order to estimate the system we make use of the two stage *Probit-Least Squares estimation method* (2SPLS) described in Maddala (1983) for simultaneous equations models.

The paper is organized as follows. In the next section we provide a detailed description of data used in the empirical analysis. Section 3 presents the estimation of grades and duration equation by equation. Section 4 introduces our theoretical model and presents the results from the two stage estimation procedure. Section 5 concludes.

2 Data

In order to fit an education production function we use a specific data set obtained by pooling two different data sources, namely the University's administrative data records (AD hence-

forth) and the *AlmaLaurea* questionnaires (AL henceforth).[1] The data collected from AD provide students' personal information such as gender, age at enrollment, age at graduation, region (province) of residence, their academic performance (grade point averages, number of passed exams *per* year, time spent to complete the study program, number of *CFU* credits accumulated during the first and the second academic year), as well as information on the students' educational experience prior to entering the university (type of high school attended and final grade achieved). All the other information derives from the AL questionnaires answered by students who are about to graduate the day before their graduation. The questionnaires address the students' social backgrounds such as the parental education level and social class, educational experiences (studying periods abroad, the duration of this experience and the number of passed exams), work experience and other training activities (including internships both at and out of the university), as well as the information related to th duration of such experiences. In addition to AD, the AL questionnaires provide data regarding the frequency of class attendance and study grants or scholarships held.

For the purposes of our analysis we consider only *undergraduate* students enrolled (for the *first* time) after the introduction of the "3+2" reform in 2001 which reduces the duration of the course programs from four or five to three academic years.[2] In such a way our data set covers all the students that graduated between the autumnal graduating session of 2004 and the autumnal graduation session of 2012.[3] We consider only *active* students, *i.e.*, students with at least one passed exam of at least 5 *CFU* credits in each academic year. We exclude students older than 35 at the moment of enrollment, those with more than 39 *CFU* recognized credits at the moment of enrollment[4] as well as individuals for whom we miss data on one or

[1] The *AlmaLaurea* is a service providing on-line graduates' curricula. It was set up in 1994 following an initiative of the Statistical Observatory of the University of Bologna and is run by a consortium of Italian universities with the support of the Ministry of Education, University and Research (http://www.almalaurea.it/).

[2] We exclude hence all those students enrolled before 2001 and subsequently switched to the post-reform system.

[3] Actually, there are four departments at the Ca' Foscari University: Economics, Literature and Philosophy, Languages, and Mathematical, Natural and Physical science. There are two ordinary (summer and winter) and one extraordinary graduation session (spring).

[4] Students with previous (concluded and non) university experience may be exonerated at the moment of enrollment of a certain amount of CFU credits according to the following criteria: students with less than 39 recognized CFU credits enroll at the first year, those with more than 40 and less than 100 pass directly

more relevant category. The resulting sample consists of almost 13300 graduates. Since Ca' Foscari is not a private institution, our sample of graduates should not differ significantly from the standards of other Italian public universities.

We consider two indicators of students' performance: the average of grades of all courses relevant for graduation (grade point averages, GPA henceforth) and the length of study (time to degree, TTD henceforth). In addition to the students' GPA we also consider their final grades at graduation. TTD is (conventionally) defined as the total amount of time passed between the date of graduation and the 5th November of the enrollment year. According to the students' TTD we define two categories of students: regular or "*On-Track*" students or those who graduate withing the minimum legal period of three academic years, and the so-called "*Out-of-Track*" students or those who graduate above the minimum legal period. In order to analyze the probability of graduating within the minimum period we define a dummy variable that takes the value of 1 when the graduation occurs within the minimum period and 0 elsewhere. Grades in the Italian education system are numerical and range from 18 (sufficiency) to 31 over 30 where 31 refers to "30 *cum laude*".

The students' GPA in our sample range from 20.25 to 30, with an average of 25.77. The average length on the other hand is 3.76 years (Table 7 in Appendix). The minimum graduation time is 2.6 years while the slowest student takes almost 11 years to graduate. The presence of 44% of the "*Out-of-Track*" graduates is not surprising since Italian students are not obliged to take exams at the end of courses rather they can freely choose any of the main exam sessions usually held in January/February, May/June and September. Around 31.8% of students in our sample can be classified as "excellent" with a GPA above (or equal to) 27; 46.4% are "good" with a GPA between 24 and 27; 21.5% are "satisfactory" (GPA between 21 and 24) while only 0.34% of students are "barely passing" (GPA lower than 21). The GPA is highest for the department of Literature and Philosophy (27.19) and lowest for the Economics department (24.24). For the final score the Italian tertiary system uses a 110 point scale with 66 being the minimum grade for passing. The 110 point takes into consideration

to the second year, while those with more than 100 CFU credits enroll to the third year.

both the grade point averages and the final thesis. For outstanding results, the so-called "*Lode*" may be added to the maximum grade. In such a way the maximum achievable grade is "110 and *Lode*" (110 *cum laude*) coded here as 111. The average final grade of all Ca' Foscari graduates is slightly higher than 100 (100.8), and ranges from a minimum of 76 to a maximum of 111. The average final grade of those who graduate in Economics is significantly lower than the average (95.85), while those reading Literature, Languages, and Science earn on average higher final grades (104.82, 102.78 and 101.09 respectively).

Students in our sample earn on average 49.81 and 53.02 *CFU* credits during their first and the second academic year respectively which represents 83% and 88% of the expected amount of *CFU* credits for each academic year (60). Figure 8 and Figure 9 (in Appendix) represent the distribution of *CFU* credits acquired during the first and the second academic year by department (previously faculty).[5] Students reading languages earn on average more credits during their first and the second year (56.3 and 57.4 respectively) with respect to those from the Literature (47.04; 51.4), Economics (47.26; 51.9), or Science department (43.88; 46.63). Moreover, almost 75% of graduates declare to have attended 75% or more of all scheduled lectures. Students in our sample pass on average 9.7 exams during their first year and 10 during the second acquiring on average 5.3 and 5.6 credits per exam respectively.

Table 9 (in Appendix) shows the distribution of graduates with respect to grades and duration. Students that graduate "*On-Track*" with a GPA of at least 27 represent 23.4% of all Ca' Foscari graduates. These students earn on average 59 *CFU* credits during their first academic year and have a high school grade equal almost to 90. Similarly, those graduated "*On-Track*" with a GPA lower than 27 (32.6% of all graduates) earn on average 55.7 *CFU* credits during their first year and have a lower high school grade (83.1). Who graduates "*Out-of-Track*" with high GPA higher or equal to 27 (8.4%) earn on average 42.8 first year *CFU* credits and have an average high school grade equal to 83.9 points while those "*Out-of-Track*" with a GPA inferior to 27 (35.5%) have low high school grades (77.7) and earn 40.3 *CFU* credits during their first year. The most efficient students hence, both in terms of

[5]Following a recent university reform in 2012, traditional "Faculties" have been aggregated into "Departments".

grades and time to degree, are those with satisfactory high school performance and regular university career (in terms of *CFU* credits and attendance).

In the following two sections we consider a simple education production function and analyze the main determinants of academic achievements. In the first part we consider grades and time to graduation as independent variables. In the second part we argue that grades and duration are both endogenous, *i.e.*, there may be a reciprocal causation between them, and we propose a simple theoretical model of the trade-off between the two. Finally, we reestimate our equations using a two stage model for simultaneous equations by instrumenting grades and duration.

3 Determinants of Academic Achievements

Two main indicators of students' performance are considered as the dependent variables, namely the students' GPA and TTD. In addition, we also consider the students' final grades at graduation and their "*On-Track/Out-of-Track*" status.[6] The set of independent variables, on the other hand, is divided into five different categories:

I. **Personal Characteristics and Family Backgrounds**: Gender; Father's and Mother's education (primary, lower and upper-secondary degree, university degree); Social class and Family's financial condition (approximated with a dummy variable that takes the value of 1 if the student held a scholarship during at least one academic year and 0 otherwise).

II. **Prior Academic Achievement**: Final high school grade and the type of institution attended (General high schools known as "*Licei*" against Technical, Professional and Teaching high schools known as "*Istituti tecnici e professionali*"). Unfortunately, we

[6]Checchi, Franzoni, Ichino and Rustichini (2000) combine the two indicators in one single measure. The students' overall performance is measured as a product of GPA and the ratio between the number of passed exams and the number of years of active enrollment (with the latter ratio denominated as the "speed" at which a student is undertaking the exams). Here we consider them separately also because we intend to apply two different estimation methods and address in detail the relationship between grades and duration.

do not have a complete information on whether a particular high school is private or public.

III. **Academic Track at University and Peer Group Effects**: Faculty (department); Age at the moment of enrollment; Class attendance; Periods spent abroad under the *Erasmus* exchange program; Occasional jobs (part-time or full-time for at least 1/2 of academic career) and Internships (both at and out of the university). In order to analyze the effects of academic track regularity on academic success we consider the number of *CFU* credits accumulated during the first and the second academic year, the number of exams in the first two years of academic career, and the average number of *CFU* credits *per* exam. Two different measures of peer group effects are considered: average final high school grade for each cohort of enrolled students and each department, and the average family income (approximated by scholarships held by students)[7] for each year of enrollment and each department. In addition, we consider the total amount of time employed in the preparation of the final thesis.

IV. **Mobility**: Region and Province of residence.

V. **Labor Market Conditions**: The rate of unemployment *per* department (faculty) of origin (at the national level). These data originates from the AL surveys conducted one year after the graduation for a sub-sample of Italian graduates.

3.1 Grades and Duration: Estimation Issues

The data considered in this study are missing the students who transfered from Ca' Foscari University to other universities or voluntarily withdrew for any other reason. We assume however that those transfers and withdrawals are randomly distributed and do not bias the

[7] In general, there are several criteria that a student has to fulfill in order to obtain/maintain a scholarship. In addition to the family's income level (ISEE), s/he is obliged to earn a certain amount of *CFU* credits in each year in which the scholarship is perceived. Holding a scholarship, hence, may not proxy only the students' financial condition, but also his/her ability level or effort. However, since the primary criteria to apply for a scholarship is the family's income at the beginning of the student's academic career, and since we take into account all those students that perceived the scholarship for at least one academic year, this information can represent a good proxy for individual's financial condition.

remaining sample. Moreover, our dependent variables are limited both from below and from above but no observation is excluded from the analysis only because of the value of the dependent variable.[8] This means that our sample is not drawn from a restricted part of the population. However, since our dependent variables are limited, it is necessary to address the problem of the out-of-range predicted values, *i.e.,* predictions that lie above or below truncation points. If *OLS* generates a significant number of such values, the results may be seriously distorted. In that case the *truncation regression* estimation method should be applied. Another potential problem is related to heteroskedastic errors: in the presence of heteroskedasticity, the *OLS* estimates are not anymore *BLUE* in the sense that among all the unbiased estimators, *OLS* does not provide the estimates with the smallest variance. Depending on the nature of heteroskedasticity, significance tests can be too high or too low. In order to account for heteroskedasticity, we calculate robust standard errors.[9] Figure 1 (in Appendix) shows the scatter plot of the predicted GPA, final grades, and TTD versus standardized residuals generated by *OLS* for models that regress our explanatory variables on GPA and TTD.

The assumption of homoscedasticity is violated. Indeed, the White's general test confirms the presence of heteroskedasticity (even though not very strong): the error terms slightly decrease as the predicted values of the average and final grades increase while they increase as the predicted time to degree increases. In other words, the model explains more variance for students with higher average and final grades and shorter academic careers. The number of the out-of-range predictions, on the other hand, is relatively small for GPA. However, if we consider final rather than average grades as a dependent variable, we observe many predicted values higher than 111, where the final grade is truncated from above. The significant number of predicted values above the upper truncation point may distort the results. The same is true for TTD where *OLS* produces several predictions lower than 2.6. As a consequence, the

[8]Grades in the Italian tertiary education system are numerical and range from 18 (sufficiency) to 31 over 30 where 31 refers to "30 *cum Laude*". Similarly, the time to graduation is also limited since we consider only post-reform undergraduate students and we stop with the autumnal graduation session of 2012.

[9]If the difference between the robust standard errors and those obtained without the *robust* option is small then the problem of heteroskedasticity is not too serious.

truncated regression estimation method is a valid choice for final grade and duration, while in the case of GPA, the standard *OLS* procedure may apply as well.

The probability of graduating within the minimum period, on the other hand, is estimated with the standard *Probit* model with binary dependent variable equal to 1 in the case of the graduation within the minimum period and 0 elsewhere.

3.2 Things will end by the way they begin

Since one of the main purposes of this paper is to explore the relationship between students' behavior and their academic achievements, we first discuss a couple of important bivariate correlations. We claim that students' continuity and regularity in fulfilling didactic requirements is crucial for their academic performance. We consider two key indicators of academic track regularity: the number of *CFU* credits acquired during the first and the second academic year, and the average number of credits *per* exam. These two indicators of students' behavior are also those that institutions can influence to some extent through policies and practices that foster students regularity in fulfilling didactic requirements. Since each *CFU* credit requires a certain amount of time and effort to be invested in studying, exams with more credits are also more demanding and complex with respect to smaller exams and they are often scheduled at the beginning of the course programs. Moreover, bigger exams often provide students with fundamental skills necessary to efficiently undertake the subsequent and conceptually connected exams. Given all these considerations, a higher number of credits *per* exam during the first academic year may indicate an efficient behavior towards graduation. In other words, students with higher average number of credits per exam are probably those who tend to follow a regular path to get a degree in the sense that they attend courses and immediately after take the corresponding exams. Similarly, students who respect the exam schedule may also be more efficient in terms of grades. Figures 2 and 3 (in Appendix) represent the total number of credits acquired during the first year of academic career as well as the corresponding average number of credits *per* exam versus students' grade point averages by faculty/department. in addition, Figures 4 and 5 (in Appendix) show the rela-

tionship between average credits per year and time to graduation.

There is a positive association between *CFU* credits and GPA: the correlation coefficient is highest for Economics (+0.542) compared to Science (+0.485), Languages (+0.335), and Literature and Philosophy (+0.226). A similar, although not so strong positive associations are observed between the average number of the first year credits *per* exam and GPA. Regarding the time to graduation, the trends are very similar: more credits and bigger exams during the first academic year are associated with shorter academic careers. As in the case of GPA, the magnitude of the correlation coefficient is highest for Economics (-0.646) compared to Science (-0.62), Languages (-0.602), and Literature and Philosophy (-0.559).

Together with the above mentioned indicators of academic track regularity, in the empirical analysis that follows we also consider some additional information on students' academic performance such as studying periods abroad, the frequency of class attendance, internships, and occasional jobs. Moreover, we control for the number of *CFU* credits recognized at the moment of enrollment and we exclude students with more than 39 recognized credits[10]. We also construct a dummy variable to control for additional credits assigned to each student at the moment of enrollment.

3.3 Factors influencing Grade Point Averages (GPA)

In order to analyze the determinants of GPA we estimate the following empirical model:

$$y_i = \boldsymbol{\alpha}\mathbf{X}_\mathbf{i}^{'} + \epsilon_i \tag{1}$$

where y_i is the ith student's GPA, $i = 1, ..., n$, $\mathbf{X}_\mathbf{i}^{'}$ is a $K+1$ dimensional raw vector of K explanatory and control variables and a constant term, $\boldsymbol{\alpha}$ is a $K+1$ dimensional column vector of parameters and ϵ_i is error term. We do not assume that errors are both independently and identically distributed (as it is assumed by *OLS*) because the potential heteroskedasticity of the error terms may cause standard errors to be biased.

[10]See footnote 4.

Tables 1 and 2 show the results of the estimation equation by equation of the effects of students' background characteristics (individual characteristics and family backgrounds), prior academic achievements and academic performance at university on GPA and final grade at graduation. Each column presents the estimated coefficient for the variables, their associated t - statistics and the heteroskedasticity corrected standard errors.

Without controlling for individuals' academic performance, peer group effects and working experience, female undergraduate students seem to perform better in terms of GPA (Model 1). This advantage over male peers, however, is very small. Moreover, students coming from general high schools ("*Licei*") perform significantly better with respect to students from other secondary school tracks. Model 2 adds family background variables. Having a mother with university degree increases GPA by almost 0.2 while the effect of father's university degree is less pronounced. The interpretation of this result requires some caution since the type of high school attended may depend upon family backgrounds and parental education. Cappellari (2012) and Checchi, Franzoni, Ichino and Rustichini (2000), for instance, show that students with favorable educational family backgrounds select into general high schools, and have better academic performance.

Students whose parents belong to the working and middle classes perform better with respect to the "high class" family students even though these effects are not very strong. Since the categorization into social classes directly derives from the parents' employment,[11] it is also highly correlated with their income. As a consequence, holding a scholarship (which is our proxy for family income - the lower the income the higher the probability of holding a scholarship) is associated with better academic performance.

Model 3 introduces the first two indicators of academic track regularity, namely the number of credits acquired during the first and the second academic year. The results suggest that there is a positive and significant association between *CFU* credits and GPA. Coefficients

[11] Whether a student belong to one social class or another depends on the parents' employment (working class - simple workers, employees; middle class - entrepreneurs with less than 15 employees, member of cooperatives, own - account workers, coordinators etc.; high class - executives, entrepreneurs with more than 15 employees).

in Model 3 suggest that 10 more credits during the first academic year is associated with 0.23 point increase in GPA. However, the marginal impact of credits should be "corrected" by the size of the associated exams. This means that credits associated to bigger exams may have a different weight in affecting the students' GPA. In order to control for the exam size, Models 4 and 5 introduce the average number of credits *per* exam. We can see from Model 4 that higher is the average number of credits *per* exam, higher is GPA. The ratio between the number of exams and their size may increase both because of an increase in the number of credits or because there are fewer exams for a given number of credits. When we control for the number of credits (Model 5), we see that for a given number of credits, higher is the ratio between credits and exams, higher is the average exam score which indicates that students who undertake "bigger" exams during their first academic year obtain higher exam scores. Interestingly, the marginal impact of the average credits per exam in the second academic year is negative which indicates that students who pass more exams during their second year have also higher exam scores compared to students with the same amount of credits and fewer exams (Models 6 and 7). This is an interesting evidence since it suggests that a combination between bigger first year exams and smaller second year exams increases the students' GPA. In addition to the number of first and second year *CFU* credits and the corresponding average number of credits *per* exam, we also control for the average number of credits per *department* of origin. The effect of bigger exams or larger blocks of credits during the first academic year on GPA is positive for Economics and Science department and negative for the Literature department. This result may reflect the fact that exams that provide students with technical and theoretical skills are usually scheduled a the beginning of the course program and may increase the students' overall efficiency in the rest of their academic career.

Coefficients in Model 6 suggest that after controlling for the number of exams (and, hence, for their size in terms of the *CFU* credits), having acquired 10 more credits during the first academic year, translates into 0.42 points increase in GPA. Other indicators of academic performance are all significant with the expected sign: participating in the *Erasmus*

international exchange program increases the average grade by 0.53, students who declare to attend 75% or more of all scheduled lectures have more than 0.21 points higher average grades with respect to students who attend less than 75%, while occasional and/or full-time workers earn lower average scores compared to a non-working peers. Comparing Model 1 and Model 6, we note that after entering first year experiences to the model, the effects of individual and family characteristics, and prior academic achievements remain significant, but decrease in magnitude. Family background characteristics and prior academic achievement are hence associated to a non trivial degree to students' academic performance but do not explain everything that matters for students academic success - their first year academic experiences are also very important, *ceteris paribus*.

In Model 7 we introduce two "Peer Effects": the average high school grade and the proportion of students holding a scholarship by department and year of enrollment. The former is a measure of the peers' average ability level while the latter approximates the peers' average financial condition. Only the proportion of peers holding a scholarship results and significant. Finally, Model 8 replicates Model 7 using a truncated regression estimation. As we can see there is no significant deviation from the *OLS* estimates, both in magnitude and the level of significance.

Table 2 reports the quintile regression estimates for equation (1). We consider four quintiles: 0.25, 0.5, 0.75 and 0.9.[12] In order to facilitate the comparison between estimates of different quintiles with those from the *OLS* regression estimation, we report the latter in the last column. The magnitude and the marginal effects of class attendance, holding a scholarship, and the number of credits and exams during the first two years of academic career increase when we move from a lower to a higher quantile. The significance of parents holding a university degree increases too and reaches its maximum at the 90% quantile. Interestingly, having a father with the university degree is important only for the highest quintile, and the magnitude of this impact is almost five times larger compared to the lowest quintile of grade distribution.

[12]We use a bootstrap estimator for the standard errors in all models.

Finally, Table 5 (in Appendix) replicates Table 1 using the final grade at graduation as a dependent variable. As we have already mentioned in the introduction, the Italian tertiary system uses a 110 point scale with 66 being the minimum grade for passing. Since *OLS* generates many predictions that fall out of range, we apply a truncated regression estimation. Students whose mother (father) possesses a university degree have on average 1.2 (0.5) higher final grades (Model 6). Similarly, students from working class families seem to perform better with respect to "high class" family students although this advantage is quite weak. Having done a general high school increases significantly the final grade at the university. This effect ranges from approximately 5.7 points in the case of the general classic high schools to 2.6 for the linguistic general high schools. Credits acquired during the first and the second academic year have a strong and significant impact on final grades: a 10 points increase in the first year credits is associated with 2.4 points higher final grades, while the same increase in the second year credits translates into less than 1 point increase in final grades. As before, there is a positive association between final grades and average number of credits *per* exam. However, for any given number of credits, more exams during the second academic year is associated with higher final grade. We can conclude that students who undertake bigger (smaller) exams during their first (second) academic year reach higher final grades.

Table 1: *Results From the* ***OLS Estimation*** *of the Determinants of Academic Performance: Grade Point Averages (2004 - 2012)*

Variable	**OLS 1** Coeff./SE	**OLS 2** Coeff./SE	**OLS 3** Coeff./SE	**OLS 4** Coeff./SE	**OLS 5** Coeff./SE	**OLS 6** Coeff./SE	**OLS 7** Coeff./SE	**Truncated** Coeff./SE
Gender	0.077***	0.079***	0.017	0.038	0.012	0.008	0.007	-0.006
	0.029	0.030	0.028	0.029	0.028	0.028	0.028	0.029
Age at Enrollment	0.053***	0.051***	0.082***	0.076***	0.080***	0.080***	0.080***	0.084***
	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
High School Grade	0.074***	0.074***	0.059***	0.070***	0.059***	0.059***	0.059***	0.063***
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
General Classic	1.036***	1.003***	0.858***	0.937***	0.850***	0.844***	0.842***	0.937***
	0.041	0.043	0.041	0.042	0.041	0.041	0.041	0.045
General Scientific	0.894***	0.879***	0.719***	0.803***	0.702***	0.700***	0.701***	0.744***
	0.032	0.033	0.032	0.033	0.032	0.032	0.032	0.033
General Linguistic	0.535***	0.531***	0.452***	0.477***	0.438***	0.431***	0.431***	0.454***
	0.041	0.041	0.039	0.040	0.039	0.039	0.039	0.042
Professional	-0.458***	-0.503***	-0.324***	-0.505***	-0.350***	-0.360***	-0.358***	-0.396***
	0.074	0.076	0.073	0.075	0.073	0.073	0.073	0.076
Mother Univ. Degree		0.163***	0.131***	0.122***	0.124***	0.122***	0.124***	0.143***
		0.043	0.041	0.042	0.041	0.041	0.041	0.045
Father Univ. Degree		0.087**	0.073*	0.060	0.068*	0.070*	0.069*	0.079*
		0.040	0.038	0.039	0.038	0.038	0.038	0.041
Working Class		0.098**	0.075**	0.091**	0.077**	0.082**	0.082**	0.090**
		0.040	0.038	0.039	0.038	0.038	0.038	0.040
Middle Class		0.079**	0.048	0.066**	0.050	0.052*	0.053*	0.060*
		0.033	0.030	0.032	0.030	0.030	0.030	0.032
Scholarship		0.163***	0.086***	0.134***	0.088***	0.090***	0.085***	0.086***
		0.032	0.030	0.031	0.030	0.030	0.030	0.032
Credits 1st year			0.023***		0.022***	0.042***	0.041***	0.043***
			0.001		0.001	0.002	0.002	0.003
Credits 2nd Year			0.014***		0.015***	0.011***	0.011***	0.011***
			0.001		0.001	0.002	0.002	0.002
Average credits by exam 1st Year				0.184***	0.117***			
				0.016	0.022			
Average credits by exam 2nd Year				0.029**	-0.015			
				0.011	0.011			
Number Exams 1st Year						-0.106***	-0.103***	-0.108***
						0.012	0.012	0.013
Number Exams 2nd Year						0.021**	0.023***	0.027***
						0.009	0.009	0.010
Av.1st*Economics					0.056**	0.044*	0.040	0.027
					0.028	0.025	0.025	0.026
Av.1st*Literature					-0.258***	-0.317***	-0.313***	-0.312***
					0.033	0.033	0.035	0.039
Av.1st*Science					0.058*	0.068***	0.063**	0.060**
					0.031	0.026	0.026	0.028
Credits Recognized			0.018***	0.009**	0.017***	0.016***	0.016***	0.016***
			0.004	0.004	0.004	0.004	0.004	0.004
Credits "Debt"			-0.130***	-0.249***	-0.190***	-0.226***	-0.217***	-0.222***
			0.024	0.029	0.028	0.029	0.029	0.031
Erasmus			0.526***	0.457***	0.528***	0.529***	0.530***	0.582***
			0.041	0.041	0.041	0.041	0.041	0.045
Attendance > 75%			0.237***	0.402***	0.213***	0.213***	0.213***	0.226***
			0.028	0.028	0.028	0.028	0.028	0.029
Internship at Univ.			0.002	-0.022	-0.008	0.004	-0.000	-0.014
			0.042	0.043	0.042	0.041	0.041	0.046
Internship not at Univ.			-0.132***	-0.122***	-0.109***	-0.101***	-0.102***	-0.133***
			0.032	0.032	0.032	0.032	0.032	0.034
Occasional Jobs			-0.071**	-0.138***	-0.068**	-0.069**	-0.068**	-0.072**
			0.030	0.031	0.030	0.030	0.030	0.032
Workers			-0.275***	-0.380***	-0.247***	-0.245***	-0.246***	-0.253***
			0.071	0.073	0.070	0.070	0.070	0.073
PeerAbility							0.012	0.015
							0.012	0.013
PeerIncome							1.805***	1.864***
							0.599	0.630
Economics	-1.913***	-1.889***	-1.528***	-1.724***	-1.842***	-1.789***	-1.609***	-1.529***
Literature	1.008***	1.017***	1.350***	1.331***	2.603***	2.925***	2.978***	3.149***
Science	-0.463***	-0.439***	0.003	-0.472***	-0.427**	-0.469***	-0.285	-0.237
N. Observations	13279	12807	12710	12710	12710	12710	12710	12710
R Squared	0.548	0.551	0.602	0.576	0.604	0.605	0.606	-

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Robust Standard Errors in parenthesis. Reference categories: Males, High Class, Residence in the South, Department of Languages. The residence dummy variables are not shown for the sake of space.*

Table 2: **Quintile Regression** *Dependent Variable: Grade Point Averages (2004 - 2012)*

Variable	**Qt25** Coeff./SE	**Qt50** Coeff./SE	**Qt75** Coeff./SE	**Qt90** Coeff./SE	**OLS** Coeff./SE
Gender	0.002	0.010	0.001	-0.075*	0.008
	0.041	0.035	0.041	0.039	0.028
Age at Enrollment	0.061***	0.086***	0.098***	0.107***	0.080***
	0.012	0.011	0.018	0.021	0.009
High School Grade	0.062***	0.061***	0.060***	0.056***	0.059***
	0.002	0.001	0.001	0.002	0.001
General Classic	0.935***	0.842***	0.782***	0.659***	0.842***
	0.059	0.044	0.059	0.047	0.041
General Scientific	0.712***	0.737***	0.734***	0.674***	0.701***
	0.040	0.040	0.036	0.053	0.032
General Linguistic	0.483***	0.429***	0.458***	0.361***	0.431***
	0.052	0.045	0.055	0.068	0.039
Professional	-0.409***	-0.348***	-0.337**	-0.243	-0.358***
	0.079	0.118	0.133	0.176	0.073
Mother Univ. Degree	0.048	0.111**	0.223***	0.179**	0.124***
	0.046	0.051	0.074	0.081	0.041
Father Univ. Degree	0.037	0.061	0.015	0.130**	0.069*
	0.053	0.051	0.033	0.062	0.038
Working Class	0.120**	0.021	-0.007	0.147**	0.083**
	0.047	0.052	0.061	0.070	0.038
Middle Class	0.076**	0.020	0.011	0.038	0.053*
	0.038	0.037	0.051	0.046	0.030
Scholarship	0.012	0.086*	0.158***	0.147**	0.085***
	0.035	0.050	0.040	0.062	0.030
Credits 1st year	0.033***	0.042***	0.046***	0.045***	0.041***
	0.003	0.004	0.003	0.004	0.002
Credits 2nd Year	0.015***	0.012***	0.008***	0.006*	0.011***
	0.002	0.002	0.002	0.003	0.002
Number Exams 1st Year	-0.060***	-0.105***	-0.145***	-0.143***	-0.103***
	0.016	0.020	0.016	0.018	0.012
Number Exams 2nd Year	0.001	0.023**	0.036***	0.038***	0.023***
	0.010	0.010	0.012	0.012	0.009
Av.1st*Economics	0.043	0.070**	0.047	0.020	0.040
	0.043	0.031	0.050	0.030	0.025
Av.1st*Literature	-0.307***	-0.314***	-0.347***	-0.262***	-0.313***
	0.049	0.054	0.046	0.065	0.035
Av.1st*Science	0.077***	0.054	0.044	-0.010	0.063**
	0.027	0.035	0.051	0.047	0.026
Credits Recognized	0.019***	0.016***	0.013**	0.015**	0.016***
	0.005	0.004	0.006	0.007	0.004
Credits "Debt"	-0.181***	-0.244***	-0.263***	-0.230***	-0.217***
	0.053	0.049	0.031	0.062	0.029
Erasmus	0.608***	0.558***	0.429***	0.301***	0.530***
	0.054	0.044	0.048	0.072	0.041
Attendance $> 75\%$	0.185***	0.223***	0.274***	0.287***	0.213***
	0.039	0.035	0.040	0.045	0.028
Internship at Univ.	0.006	-0.025	-0.005	0.024	-0.000
	0.051	0.053	0.040	0.074	0.041
Internship not at Univ.	-0.187***	-0.123***	-0.054	-0.038	-0.102***
	0.053	0.042	0.041	0.044	0.032
Occasional Jobs	-0.094**	-0.066*	-0.053	-0.049	-0.068**
	0.045	0.035	0.042	0.049	0.030
Workers	-0.289***	-0.166**	-0.219*	-0.216**	-0.246***
	0.087	0.070	0.124	0.092	0.070
PeerAbility	0.017	0.004	0.006	0.013	0.012
	0.015	0.017	0.020	0.020	0.012
PeerIncome	2.253**	2.091**	1.807*	0.923	1.806***
	1.058	0.910	0.946	0.948	0.599
Economics	-1.548***	-1.817***	-1.746***	-1.503***	-1.609***
Literature	3.023***	3.064***	3.145***	2.609***	2.978***
Science	-0.288	-0.164	-0.148	0.023	-0.285
N. Observations	12710	12710	12710	12710	12710
Pseudo R Squared (R Sq - OLS)	0.405	0.4	0.365	0.316	0.608

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Robust Standard Errors in parenthesis. Reference categories: Males, High Class, Residence in the South, Department of Languages. The residence dummy variables are not shown for the sake of space.*

3.4 Factors influencing Time to Degree (TTD)

The excess time to degree has become a major concern in several European countries (Aina, Baici and Casalone, 2011; Garibaldi et al., 2007; Brunello and Winter-Ebmer, 2003) and USA (Bowen, Chingos and McPherson, 2009; Bound, Lovenheim and Turner, 2010). Understanding the determinants of this phenomenon is very important since delayed graduation postpones the transition from university to labor market which in turn diminishes the labor supply and also entails a social loss in terms of fiscal revenues (Hakkinen and Uusitalo, 2002), especially in countries where tertiary education is highly publicly subsidized. Moreover, longer voluntary time to degree entails a private cost to individuals since delayed graduation is often associated with irregular academic careers, which may deteriorate the stock of acquired knowledge and skills. Delayed graduation may also have a negative impact on wages at the beginning of students' working career (Monks, 1997; Brodaty, Gary Gobo and Prieto, 2008) and on the probability of finding a job (Aina and Casalone, 2011).

As with most economic phenomena, the quantity of time employed to graduate may be a matter of choice. Let's denote the net benefit to student i of graduating within the minimum period as U_i^{IC} and the net benefit of staying longer in the university as U_i^{FC}. The superscripts IC and FC refer to "In-Corso" or "On-Track" and "Fuori-Corso" or "Out-Of-Track" respectively. For simplicity, we assume that each benefit function is *additive* in each year in which a student is enrolled:

$$\begin{aligned} U_i^{IC}(\mathbf{X}_i) &= \alpha_0^{IC} + \boldsymbol{\alpha_1^{IC}}\mathbf{X}_i + \phi_i^{IC} \\ U_i^{FC}(\mathbf{X}_i) &= \alpha_0^{FC} + \boldsymbol{\alpha_1^{FC}}\mathbf{X}_i + \phi_i^{FC} \end{aligned} \tag{2}$$

Let $\gamma_0 \equiv \alpha_0^{IC} - \alpha_0^{FC}$, $\boldsymbol{\gamma_1} \equiv \boldsymbol{\alpha_1^{IC}} - \boldsymbol{\alpha_1^{FC}}$, and $\epsilon_i \equiv \phi_i^{IC} - \phi_i^{FC}$. Then, a student i that prefers graduating within the minimum period is modeled as:

$$\gamma_0 + \boldsymbol{\gamma_1}\mathbf{X}_i + \epsilon_i \geq 0 \tag{3}$$

In other words, the expression in (3) defines our *latent* variable:

$$y_i^*(\mathbf{X}_i, \gamma_0, \boldsymbol{\gamma_1}) \equiv \gamma_0 + \boldsymbol{\gamma_1}\mathbf{X}_i + \epsilon_i. \tag{4}$$

We cannot observe the exact value of latent variable for any individual in our sample, but we can observe the outcome of the individual having followed the decision rule

$$y_i = \begin{cases} 0 & \text{if} \quad y_i^* < 0 \\ 1 & \text{if} \quad y_i^* \geq 0. \end{cases}$$

In other words, individuals with $y_i^* < 0$ graduate above the minimum period while those with $y_i^* \geq 0$ conclude their academic careers within the minimum or legal period. If we assume that the error terms in (4) are *i.i.d.*, $\epsilon_i \mid \mathbf{X}_i \sim N(0,1)$, we can define the probability of graduating within the minimum period as

$$\begin{aligned} Pr(y_i = 1|\mathbf{X}_i, \gamma_0, \boldsymbol{\gamma_1}) &= Pr(\gamma_0 + \boldsymbol{\gamma_1}\mathbf{X}_i + \epsilon_i \geq 0|\mathbf{X}_i) \\ &= Pr(\epsilon_i \leq \gamma_0 + \boldsymbol{\gamma_1}\mathbf{X}_i|\mathbf{X}_i) \\ &= \Psi(\gamma_0 + \boldsymbol{\gamma_1}\mathbf{X}_i|\mathbf{X}_i). \end{aligned} \tag{5}$$

On the other hand, the probability of graduating above the minimum period is just $Pr(y_i = 0|\mathbf{X}_i, \gamma_0, \boldsymbol{\gamma_1}) = 1 - \Psi(\gamma_0 + \boldsymbol{\gamma_1}\mathbf{X}_i|\mathbf{X}_i)$ where Ψ is the cumulative density function of the normal distribution that maps point on the real line into the probability measure. The equation (5) defines the "Probit" model. If we were to define the cumulative density function using the logistic instead of normal distribution we would get the "Logit" model. These two models produce similar results if the distribution of the dependent variable (in this case y_i) is not too extreme.

Table 3 shows the results obtained from the estimation of the "Probit" model defined in (5). As it was the case with GPA, there is a positive and statistically significant association between the number of credits acquired during the first two years of academic career and graduating in time. This effect if also quite strong.

Table 3: **Probit Regression** *of the Determinants of Academic Performance: "OnTrack" (dummy = 1 if graduation occurs within the Minimum Period) (2004 - 2012)*

Variable	**Model 1** Coeff./SE	**Model 2** Coeff./SE	**Model 3** Coeff./SE	**Model 4** Coeff./SE	**Model 5** Coeff./SE	**Model 6** Coeff./SE
Gender	0.167***	0.163***	0.077**	0.101***	0.080**	0.076**
	0.026	0.027	0.035	0.029	0.035	0.035
Age at Enrollment	-0.009	-0.010	0.065***	0.041***	0.070***	0.069***
	0.008	0.008	0.012	0.009	0.012	0.012
High School Grade	0.031***	0.031***	0.007***	0.029***	0.008***	0.008***
	0.001	0.001	0.001	0.001	0.001	0.001
General Classic	0.321***	0.343***	0.168***	0.303***	0.161***	0.165***
	0.040	0.043	0.054	0.045	0.054	0.054
General Scientific	0.350***	0.366***	0.182***	0.316***	0.190***	0.191***
	0.030	0.031	0.039	0.033	0.039	0.039
General Linguistic	0.145***	0.170***	0.078	0.137***	0.067	0.069
	0.040	0.041	0.051	0.043	0.051	0.051
Professional	-0.335***	-0.329***	-0.007	-0.333***	-0.009	-0.011
	0.069	0.071	0.088	0.075	0.087	0.087
Mother Univ. Degree		0.010	0.052	0.013	0.035	0.041
		0.040	0.053	0.042	0.053	0.053
Father Univ. Degree		-0.030	-0.031	-0.053	-0.032	-0.030
		0.038	0.048	0.040	0.048	0.048
Working Class		-0.003	-0.086*	-0.029	-0.087*	-0.089*
		0.038	0.047	0.040	0.048	0.048
Middle Class		0.040	-0.022	0.025	-0.018	-0.019
		0.031	0.039	0.032	0.039	0.039
Scholarship		0.148***	0.073*	0.145***	0.074*	0.068*
		0.030	0.038	0.032	0.038	0.038
Credits 1st year			0.067***		0.062***	0.068***
			0.002		0.002	0.003
Credits 2nd Year			0.047***		0.047***	0.062***
			0.001		0.001	0.003
Average credits by exam 1st Year				0.218***	0.113***	
				0.019	0.028	
Average credits by exam 2nd Year				0.207***	0.125***	
				0.014	0.016	
Number Exams 1st Year						-0.023
						0.016
Number Exams 2nd Year						-0.082***
						0.013
Av.1st*Economics					0.017	0.086**
					0.039	0.037
Av.1st*Literature					-0.053	-0.041
					0.061	0.062
Av.1st*Science					-0.098***	-0.028
					0.035	0.031
Credits Recognized			-0.001	-0.019***	-0.007	-0.004
			0.005	0.004	0.005	0.005
Credits "Debt"			-0.481***	-0.370***	-0.629***	-0.610***
			0.039	0.033	0.041	0.042
Erasmus			0.110*	-0.151***	0.111*	0.116*
			0.059	0.047	0.060	0.060
Attendance > 75%			0.296***	0.563***	0.291***	0.289***
			0.035	0.029	0.035	0.035
Internship at Univ.			0.067	0.029	0.107*	0.094*
			0.055	0.046	0.056	0.056
Internship not at Univ.			0.048	0.049	0.083**	0.072*
			0.041	0.034	0.042	0.042
Occasional Jobs			-0.119***	-0.240***	-0.115***	-0.117***
			0.037	0.033	0.037	0.037
Workers			-0.842***	-0.790***	-0.815***	-0.820***
			0.107	0.077	0.106	0.106
Unemployment rate			0.006	-0.074***	-0.033***	-0.028***
			0.007	0.007	0.009	0.008
PeerAbility						0.014
						0.016
PeerIncome						3.979***
						0.746
Economics	-0.304***	-0.298***	0.244***	-0.808***	-0.138	-0.142
Literature	-0.202***	-0.196***	0.473***	-0.014	0.788***	0.830***
Science	-0.481***	-0.473***	0.401***	-1.240***	0.588***	0.560**
N. Observations	13279	12807	12710	12710	12710	12710
R Squared	0.091	0.093	0.447	0.191	0.457	0.456

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Robust Standard Errors in parenthesis. Reference categories: Males, High Class, Residence in the South, Department of Languages. The residence dummy variables are not shown for the sake of space.*

For instance, passing from 54 to 60 credits during the first academic year increases the probability of graduating in time by 14.6% (for a representative student with the average number of credits and exams in the second academic year). The results also suggest that students that undertake "bigger" exams during the first two years have higher probability to graduate withing the minimum period and this probability increases as the number of exams *per* increases. Similarly, students who attend more than 75% of all scheduled lectures have a significantly higher probability of graduating in time compared to other students. Part and full time workers have lower probability to graduate in time, while internships increase the probability of being "On-Track". The effects of family income (that goes through the scholarship and social class variables) result quite week and ambiguous. Interestingly, the parental educational level does not result significant. Finally, the graduates' unemployment rate is inversely related to the probability of graduating "On-Track". A marginal increase in the rate of unemployment translates into a more than proportional reduction of the probability to graduate within the minimum legal period.

Finally, in Table 6 (in Appendix) we consider the time employed to graduate expressed in years. The standard *OLS* procedure in this case generates a significant number of predicted values below the lower truncation point (2.6) which may distort the results generated by the standard *OLS* estimation method. As a consequence, we apply the *truncated regression* method instead of *OLS* to estimate the determinants of the study duration. As we can see, the main results do not change (except for the father's education which is now significant with the expected sign).

4 The choice between Grades and Duration

Since in many tertiary education systems (like the Italian one) students can freely choose the number of semesters and the standard in terms of the leaving grade, there is a significant variation in study duration and grades across different individuals. Some students may wish to postpone their graduation in order to reach a higher leaving grade if they believe that higher grades signal better quality and increase their chances of a good placement in the

labor market. However, students with longer time to graduation may be perceived as less able by the job market, *ceteris paribus*, which means that the students who decide to repeat a grade or resit an exam a year later, gain nothing on average (Brodaty, Gary Gobo and Prieto, 2008).[13] Similarly, several individual characteristics such as the level of ability or skills acquired prior to entering the university, financial condition or labor market variables (like unemployment rate of college graduates, college wage gap, employment protection, real interest rate, etc.), may influence as well the individuals' expected time to graduation (Brunello and Winter-Ebmer, 2003; Messer and Wolter, 2010) and the average grade.[14] For instance, students with higher ability may graduate faster with higher leaving grades, *ceteris paribus*, those with lower family income may need to have a part time job to finance their studies devoting less time to study and lengthening their academic careers. Checchi et al. (2000) and Boero, Laureati and Naylor (2005) show that time to degree is inversely related to individual characteristics, family background and family's financial condition. The effects of both financial condition and ability may however be mediated by market conditions and students' behavior regarding the fulfillment of scheduled didactic requirements.

Time to graduation and leaving grade are to some extent a matter of individual choice. In this section we propose a simple theoretical model of a trade-off between grades and study duration. We consider an educational system in which students can freely choose how many semesters to employ to graduate and the average grade they want to reach at the end of their academic career. We assume that all the students conclude successfully their academic career, *i.e.*, there is no voluntary or involuntary "drop-out". Once enrolled at university, each student is conscious, to some extent, that investing in human capital affects the probability of finding an occupation and/or the expected level of future remuneration. We assume that the level of human capital acquired during the academic career is given as a combination of

[13]This is the famous Spence's (1973) signaling hypothesis: if employers imperfectly observe the relevant characteristics of job applicants, a number of observable characteristics can become signals in the sense of Spence and play a role in the determination of wages.

[14]A similar, although different analysis has been performed by Dellas and Koubi (2003). The authors examine the relationship between the school enrollment rates and business cycles and argue that the overall pattern is countercyclical. People are more likely to attend school in "bad times" when unemployment is high and wages are relatively low. Moreover, as in Messer and Wolter (2010), the authors find an increase in the real interest rate is associated with a reduction in school enrollment rates.

the average grade obtained at exams, and the time employed to graduate.

4.1 The Basic Model

Consider a simple educational system with one representative student endowed with a strictly positive ability $\overline{a} \in (0,1)$ and (family) income $\overline{m} \in (0,1)$. The parameter $\overline{a}$ can be interpreted as the amount of skills acquired prior to entering university (like high school or other professional trainings), or as the individual's innate intellectual ability or mental capacity.[15] Suppose that the minimum and the maximum (legal) academic career duration is s^{min} and $s^{max} \equiv \overline{s}$ respectively. Without loss of generality assume $s^{min} = 0$ and $\overline{s} = 1$.[16] Any $s \in (0,1)$, hence, represents the excess time to graduation. The student has direct control over s, in the sense that s/he is free to choose any $s \in (0,1)$. Since we are interested in modeling a trade-off between grades and excess time to degree, we rule out the possibility of graduating in time ($s = 0$). Moreover, we assume that no student graduates with the maximum legal career duration, *i.e.*, $s \neq 1$. These are only simplifying assumptions which does not change the main implications of the model.

For any $s \in (0,1)$, we define a variable "time savings", TS, as a difference between the maximum allowable time to degree and the student's effective career duration (in excess), *i.e.*, $TS = 1 - s$, $s \in (0,1)$. A total amount of time associated with each s in excess can be allocated in studying and other regular didactic activities on one side, and working (occasional jobs or full-time employment) or other extra-curricular activities (like internships) on the other. Let s_s denote the fraction of s allocated to studying, and s_w the fraction of s allocated to working activities, with $s_s \neq s_w$, $s_s \in (0, s]$ and $s_w \in [0, s)$. The latter restriction on the range of s_s and s_w implies that the representative student can choose to allocate the total amount of additional time to studying but not to working activities. It follows that

[15] Skills acquired in the pre-university period may as well be a function of the so-called family inputs into the cognitive achievement production which in turn may depend on the family's financial condition and/or social status. One example may certainly be the parents decision on whether to send children in public or private schools, which partly determines also the level of school inputs.

[16] The number of additional semesters is not actually limited in many tertiary education systems (the Italian one included). It hence depends on the students' preferences. We however assume that s is bounded for computational tractability reasons.

$\overline{s}$ is partitioned between studying, working (and other extra-curricular activities) and time savings, *i.e.*, $s_s + s_w + TS = \overline{s} \equiv 1$. We define a "regular student" as the one who allocates more time in studying than working activities, *i.e.*, $s_s > s_w$. Since by assumption $s_s \neq s_w$, we classify students into two different categories: i) those with *regular* academic tracks, *i.e.*, students for which $s_s - s_w > 0$ and ii) those with *irregular* academic tracks, *i.e.*, those for which $s_s - s_w < 0$.

We assume that both s_s and s_w generate returns in terms of (future) consumption benefits. Higher s_s may translate in higher grades, which in turn may signal better quality and increase the chances of a good placement in the labor market. The benefits of working or other extra-curricular activities refer to the accumulated professional experiences which may facilitate the transition from university to the labor market (Aina and Casalone, 2011). There is however an implicit cost associated with s_w because some extra-curricular activities may reduce the students' overall productivity.[17] On the other hand, the returns to s_s may depend on student's ability and/or effort exerted in studying activities (we turn to this point below). Let g_s and g_w be the amount of benefit deriving from s_s and s_w respectively, and $G \equiv g_s + g_w$ the representative student's total amount of (consumption) benefits. The student derives utility both from G and TS and s/he desires to consume the greatest possible "quantity" of grades and time savings; his or her utility function therefore increases with each argument, *i.e.*, $U_G > 0$ and $U_{TS} > 0$. The student however faces the following trade-off: in order to "produce" an additional unit of G, it is necessary to spend a positive amount of s in excess, which in turn decreases TS and U. The representative student faces the following budget constraint:

$$g_s + g_w \leq (1 + \overline{a})s_s + (1 - \overline{m})s_w$$

Given that $s_s = 1 - s_w - TS$ and $s_w = 1 - s_s - TS$, the representative student's budget

[17] We could also assume that there is a marginal cost associated to each additional unit of s - as time to degree increases, the acquired skills deteriorates or become out - of - date. However, we do not consider this in the model.

constraint can be written as:

$$g_s + g_w \leq (1 + \overline{a})(1 - s_w - TS) + (1 - \overline{m})(1 - s_s - TS)$$

or equivalently as:

$$G + TS(2 + \overline{a} - \overline{m}) \leq (2 + \overline{a} - \overline{m}) - [s_w(1 + \overline{a}) + s_s(1 - \overline{m})]. \tag{6}$$

where $G = g_s + g_w$. The marginal *net* productivities of s_s and s_w are respectively $(1 + \overline{a})$ and $(1 - \overline{m})$. Higher income, hence, implies lower marginal benefit of working. Moreover, we assume that $\overline{a}$ does not depend on s (there is no learning-by-doing). The representative student's problem consists in choosing the optimal level of G^* and TS^* in order to solve the following program:

$$\max_{G,TS} \; U(G, TS)$$

$$s.t. \;\; G + TS(2 + \overline{a} - \overline{m}) \leq (2 + \overline{a} - \overline{m}) - [s_w(1 + \overline{a}) + s_s(1 - \overline{m})] \tag{7}$$

The first order conditions yield:

$$\frac{U_{TS}(G^*, TS^*)}{U_G(G^*, TS^*)} = \frac{MU(TimeSaving)}{MU(Grade)} = 2 + \overline{a} - \overline{m}$$

and

$$G + TS(2 + \overline{a} - \overline{m}) = (2 + \overline{a} - \overline{m}) - [s_w(1 + \overline{a}) + s_s(1 - \overline{m})] \tag{8}$$

The relation (8) describes the (interior) solutions of the student's utility maximization program. The optimal combination of G and TS lies at a tangency point between the budget line whose slope is $(2 + \overline{a} - \overline{m})$ and the indifference curve corresponding to the level of utility obtained by the maximizer.

The student's preferences are represented by a standard *Cobb-Douglas* utility function:

$$U(G, TS) = \overline{u}\ logG + (1 - \overline{u})logTS,$$

with $\overline{u} \in (0, 1)$. The parameter $\overline{u}$ represents the elasticity of U with respect to G (analogously, $(1 - \overline{u})$ is the elasticity of U with respect to TS) and it can be interpreted as a proxy for the effects of economic factors such as the unemployment rate, real interest rate, changes in wages and economic growth on grades and/or time to degree. Averse labor market conditions may induce individuals to "insure" their expected probability of finding a job through an increase in average grade, which represents a good signal of quality and level of acquired human capital (skills). On the other hand, bad economic conditions may also induce students to postpone their entrance in the labor market.[18]

Solving (8) yields the optimal quantities TS^* and G^*:

$$TS^*(s_s, s_w, \overline{u}, \overline{a}, \overline{m}) = (1 - \overline{u}) \left[1 - \frac{s_w(1 + \overline{a}) + s_s(1 - \overline{m})}{2 + \overline{a} - \overline{m}}\right] \tag{9}$$

$$G^*(s_s, s_w, \overline{u}, \overline{a}, \overline{m}) = \overline{u}\ \ [(2 + \overline{a} - \overline{m}) - (s_w(1 + \overline{a}) + s_s(1 - \overline{m})] \tag{10}$$

Since $2 + \overline{a} - \overline{m} > s_w(1 + \overline{a}) + s_s(1 - \overline{m})$,[19] both TS^* and G^* are strictly positive quantities. It is also important to note that we do not assume explicitly any form of complementarity between s_s and s_w. In this model, for any *given* TS, an increase in s_s brings to a decrease in s_w. If we increase s_s and decrease s_w by the same amount, the term $[s_w(1 + \overline{a}) + s_s(1 - \overline{m})]$

[18] Messer and Wolter (2010), however, argue that high unemployment rate and high real interest rate may shorten the time to degree by directly increasing the cost of a university education since the possibility of financing one's studies by working depends on the overall labor market conditions. However, they are aware of the fact that good economic conditions such as high growth rates and/or an increase in real wages (which are tipically associated with low interest rates and low unemployment rates) shorten as well the time to degree since they increase opportunity costs of studying. What is the net effect of these two forces is still an open empirical issue.

[19] This condition can be rewritten as $2 - s_w - s_s > \overline{m}(1 - s_s) - \overline{a}(1 - s_w)$. The former term is always greater than 1 while the latter is always lower than 1, so the condition holds with strict inequality.

in (5) for instance decreases, which implies that a shift of one unit of time from working to studying (given the optimal level of time savings TS^*) increases the optimal grade level G^*. However, the relationship between s_s and s_w will be crucial for the implications of the model.

After combining (4) and (5) we obtain the following condition:

$$G^* = \frac{\overline{u}\ (2+\overline{a}-\overline{m})}{1-\overline{u}} TS^* \iff \frac{G^*}{TS^*} = \frac{\overline{u}\ (2+\overline{a}-\overline{m})}{1-\overline{u}} \tag{11}$$

which can also be written in terms of (excess) time to degree s, *i.e.*, $G^* = \overline{u}/(1-\overline{u})[(2+\overline{a}-\overline{m})(1-s)]$. The expression (11) shows that the trade-off between grades and duration depends crucially on students ability ($\overline{a}$), their financial condition ($\overline{m}$), and on market conditions ($\overline{u}$). Optimal grade and time savings (excess time to degree), hence, are *not* independent. This seemingly simple result is quite important from empirical point of view since it may help us to overcome the problem of endogeneity of time savings (excess time to degree). Given (11) we can state the following proposition:

Proposition 4.1 *For any $\overline{u} \in (0,1)$, $\overline{m} \in (0,1)$, and $\overline{a} \in (0,1)$, there is a positive relationship between time savings and grades. In other words, grades and excess time to degree are inversely related.*

In addition to $\overline{a}$, $\overline{m}$ and $\overline{u}$, the shape of TS^* and G^* is also determined by the students' academic regularity, $s_s - s_w$. In order to see this, let's consider first the marginal variations of TS^* and G^* with respect to $\overline{a}$:

$$TS^*_{\overline{a}} = (1-\overline{u})(1-\overline{m})(s_s - s_w) \tag{12}$$

$$G^*_{\overline{a}} = \overline{u}\ (1-s_w) \tag{13}$$

Since $s_w \in (0,1)$, the marginal impact of $\overline{a}$ on grade is always positive. On the other hand, the sign of the marginal impact of $\overline{a}$ on time savings depends on the relationship between s_w and s_s: it is positive for $s_w < s_s$ and negative for $s_w > s_s$. Since regular students engage more time into studying and didactic activities than in working (or other similar) activities ($s_w < s_s$), higher ability (and/or) effort is associated with higher amount of time savings, and hence lower excess time to degree, *ceteris paribus*. Given (12) and (13), we can state the following proposition:

Proposition 4.2 *For any $\overline{u} \in (0,1)$ and $\overline{m} \in (0,1)$, higher $\overline{a}$ is associated with higher G^* and TS^* as long as $s_s - s_w > 0$, ceteris paribus. In other words, regular students with higher ability earn higher grades and graduate faster.*

Moreover, it can be shown that the marginal gain of an increase in $\overline{a}$ is higher in terms of G^* than in terms of TS^*, *i.e.*, $G^*_{\overline{a}} > TS^*_{\overline{a}}$, independently of $s_s - s_w$.

Proposition 4.3 *For any $\overline{u} \in (0,1)$ and $\overline{m} \in (0,1)$, the marginal gain of an increase in $\overline{a}$ is higher in terms of G^* than in terms of TS^*.*

On the other hand, the marginal impacts of $\overline{m}$ on G^* and TS^* are respectively:

$$G^*_{\overline{m}} = -\overline{u}\,(1 - s_s) < 0 \tag{14}$$

$$TS^*_{\overline{m}} = (1 - \overline{u})\frac{1 + \overline{a}}{(2 + \overline{a} - \overline{m})^2}(s_s - s_w) \tag{15}$$

Since $s_s \in (0,1)$, the marginal impact of an increase in $\overline{m}$ on the equilibrium level of G^* is negative which means that wealthier students tend to have lower grades with respect to financially less advantaged peers. Condition (15) on the other hand implies that as long as a student regularly attends classes and other didactic activities ($s_s > s_w$), the level of income may facilitate his or her university career in the sense that wealthier students have

less need for additional earnings in order to maintain themselves. These students hence graduate faster and save more time. For any given level of income and ability, an increase in time spent on working or other extra - curricular activities decreases both grades and time savings. Conditions (14) and (15) yield the following propositions:

Proposition 4.4 *For any* $\overline{u} \in (0,1)$ *and* $\overline{a} \in (0,1)$*, higher* $\overline{m}$ *is associated with lower* G^**, ceteris paribus. On the other hand, higher* $\overline{m}$ *yields higher* TS^* *iff* $s_s - s_w > 0$*, ceteris paribus.*

Proposition 4.5 *For any* $\overline{m} \in (0,1)$*,* $\overline{u} \in (0,1)$ *and* $\overline{a} \in (0,1)$*, as* $s_s - s_w$ *increases, the average grade increases and the excess time to degree shrinks. In other words, more academic regularity means higher grades and lower time to degree.*

4.2 Grades *versus* Duration: Empirical Issues

The model developed so far suggests that grades and study duration are not independent. In this section we test empirically the predictions of the basic model using the two stage probit-least squares estimation method (2SPLS) described in Maddala (1983) for simultaneous equations models. Since grades and duration may simultaneously determine each other, *i.e.*, they are endogenous variables, the standard estimation methods would result in biased and inconsistent estimates. In order to overcome this problem, we use Keshk's (2003) CDSIMEQ method to estimate two-stage models for simultaneous equations in which one of the endogenous variables is continuous (student's grade point averages) and the other endogenous variable is dichotomous ("on-track/out-of-track" status).[20]

We consider the following two-equation generic econometric model (Gujarati, 2003):

$$y_1^* = \alpha_1 y_2^* + \beta_1 \mathbf{X_1} + \epsilon_1 \tag{16}$$

$$y_2^* = \alpha_2 y_1^* + \beta_2 \mathbf{X_2} + \epsilon_2 \tag{17}$$

[20]In general, both indirect least squares (ILS) and two stage least squares (2SLS) efficiently deal with the presence of simultaneity or reciprocal causation but consider both endogenous variables as continuous.

where y_1^* and y_2^* represent the students' grade point averages and the "on-track/out-of-track" status respectively, $\mathbf{X_1}$ and $\mathbf{X_2}$ are matrices of exogenous variables, and ϵ_1 and ϵ_2 are the error terms. Both y_1^* and y_2^* are endogenous variables since changes in y_1^* in (16) lead to changes in y_2^* via (17). Moreover, the standard assumptions underlying the OLS estimation procedure are violated, *i.e.*, $E(\epsilon_1|y_2^*) \neq E(\epsilon_2|y_1^*) \neq 0$ or $Cov(y_2^*, \epsilon_1) \neq Cov(y_1^*\epsilon_2) \neq 0$. In other words, information embodied in y_2^* are also informative about the mechanisms underlying ϵ_1, and, hence they are not mean independent.

The estimation proceeds in two steps. In the first stage we estimate the following reduced form equations:

$$y_1^* = \mathbf{\Pi_1^*}\mathbf{X} + \epsilon_1 \tag{18}$$

$$y_2^* = \mathbf{\Pi_2^*}\mathbf{X} + \epsilon_2 \tag{19}$$

where $\mathbf{X}$ is a matrix of all exogenous variables in the system and $\mathbf{\Pi_1^*}$ and $\mathbf{\Pi_2^*}$ are vectors of parameters to be estimated. Since y_1^* is a fully observed continuous variable and y_2^* is observed as a binary variable, equations (18) and (19) are estimated respectively via *OLS* and *Probit*. The predicted values obtained in the first stage, $\hat{y}_1^* = \mathbf{\hat{\Pi}_1^*}\mathbf{X}$ and $\hat{y}_2^* = \mathbf{\hat{\Pi}_2^*}\mathbf{X}$, are then used to replace the original endogenous variables in the equations and to estimate the following system:

$$y_1^* = \alpha_1 \hat{y}_2^* + \beta_1 \mathbf{X_1} + \epsilon_1 \tag{20}$$

$$y_2^* = \alpha_2 \hat{y}_1^* + \beta_2 \mathbf{X_2} + \epsilon_2 \tag{21}$$

Once again, equations (20) and (21) are estimated respectively via *OLS* and *Probit*. The estimated coefficients obtained in the second stage are biased but consistent, and hence the standard errors are wrong and need to be corrected.

The two-stage estimation procedure includes instruments for each of the two endogenous variables, *i.e.*, variables that are supposed to have effect on one but not on the other en-

dogenous variable. In addition, each equation contains a set of common regressors. In order to instrument the time taken to obtain a degree, we make use of the following variables: the graduates' rate of unemployment per department/faculty of origin, the time employed to elaborate the final thesis, the province of residence (mobility cost), and the number of recognized and debt *CFU* credits at the moment of enrollment. These variables are supposed to have a larger effect on TTD than on GPA. On the other hand, the variable that we believe can have an independent effect on grades is a binary variable that takes the value of 1 if a student has participated in the international exchange Erasmus program and 0 otherwise. The set of common regressors contain all the remaining explanatory variables and controls.

Table 4 shows the results of our estimation. The empirical evidence confirms the predictions of the model. As suggested by Proposition 4.1, there is a positive and statistically significant relationship between grades and the probability of being "On-Track" (time savings). Higher unemployment is associated with longer time to degree since unfavorable economic conditions may induce students to postpone the transition from university to labor market. Similarly, more additional credits and longer time employed to elaborate the final thesis decrease the probability of graduating within the minimum legal period. The effect of recognized credits is less clear. Participation is Erasmus international exchange program on the other hand increases significantly the students' grade point average.

Prior academic achievements (our proxy for students' ability) are positively related to GPA. Similarly, holding a scholarship translates into higher average grades which implies that higher income is associated with *lower* grades (Proposition 4.3). The coefficient on scholarship in the "On-Track" equation is also positive but not significantly different from zero. Academic track regularity has a strong and statistically significant impact both on GPA and on the probability of being "On-Track" (Proposition 4.4). More *CFU* credits during the first academic year increases the chances of graduating in time and translates into higher average GPA. Moreover, higher (lower) is the average number of the CFU credits per exam during the first (second) academic year, higher is GPA and the probability of being "On-Track". This means that bigger exams or larger blocks of credits at the beginning of academic

career translates into higher grades and shorter time to degree. Moreover, the combination between bigger and fewer first year exams and smaller but more numerous second year exams is positively related with better academic performance (in terms of GPA).

Table 4: *Results From the **2 Stage Probit Least Squares** estimation: Grade Point Averages - "On-Track/Out-Of-Track" (2004 - 2012)*

Independent Variables Exogenous and Instruments	**GPA** Equation	**OnTrack** Equation
OnTrack (I)	**0.077****	
	0.039	
Grade Point Average (I)		**0.263****
		0.130
Erasmus Exch. Program (d)	**0.522*****	
	0.049	
Unemployment Rate		**-0.042*****
		0.011
Time Thesis (months)		**-0.072*****
		0.011
Other Province (residence)		**0.139*****
		0.041
Recognized Credits		**-0.010***
		0.006
Debt Credits		**-0.581*****
		0.059
Age at Enrollment	**0.078*****	**0.055*****
	0.009	0.016
High School Grade	**0.058*****	-0.007
	0.001	0.007
Scholarship (d)	**0.068****	0.064
	0.033	0.047
Credits 1st Year	**0.017*****	**0.056*****
	0.003	0.005
Credits 2nd Year	**0.011*****	**0.043*****
	0.002	0.003
Av. Credits per Exam 1	**0.101*****	**0.085****
	0.024	0.037
Av. Credits per Exam 2	**-0.036*****	**0.133*****
	0.012	0.019
Av. Credits 1st*Economics	0.044	-0.004
	0.031	0.048
Av. Credits 1st*Literature	**-0.268*****	-0.000
	0.039	0.063
Av. Credits 1st*Science	**0.074****	**-0.119****
	0.032	0.046
Class Attendance $>$ 75% (d)	**0.191*****	**0.255*****
	0.034	0.049
Internship Univ. (d)	-0.025	**0.172****
	0.048	0.067
Internship Out Univ. (d)	**-0.113*****	**0.157*****
	0.036	0.054
Workers (d)	**-0.188****	**-0.728*****
	0.084	0.118
N. Observations	12707	12707
R Squared	0.60	0.46

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Robust Standard Errors in parenthesis. Social class, Parental education, Type of high school attended, Faculty, and Gender omitted for the sake of space and clarity.*

Another interesting evidence comes from the impact of internships on GPA and on the probability of being "On-Track". While there is generally a negative impact of internships on grades, they seem to help students to graduate faster. One possible explanation is that

internships yield some additional *CFU* credits to students or offer them the possibility to stay in the workplace where the internship has been conducted even after the graduation, which may shorten the time employed to obtain a degree with an implicit cost in terms of the final grade.

5 Concluding Remarks

In this paper we have analyzed the determinants of academic achievements of the post-reform undergraduate students of Ca' Foscari University of Venice. University's administrative records were matched with the data drawn from the *AlmaLaurea* questionnaires. In such a way we were able to associate to each graduate a large set of personal information, such as family backgrounds, prior academic achievements, academic and working experience, as well as the participation in internships and international exchange programs. We considered two main indicators of academic performance, namely the students' grade point averages and time taken to obtain a degree. Particular attention has been paid to the role of students' behavior regarding the fulfillment of didactic requirements as well as to the importance of timing (or sequence) in undertaking the scheduled exams. In order to address the problem of endogeneity, we proposed a simple theoretical model of a trade-off between grades and duration and tested its predictions in a two stage estimation procedure.

We find a positive impact of prior academic achievements on grades and on the probability of graduating in time. Our empirical results confirm the importance of parental education for grades but not for time to graduation. Moreover, grades and the probability of graduation within the minimum legal period are inversely related to family's income. We find a strong and significant impact of the first year credits on grades and duration. Moreover, the combination of bigger first year exams (or blocks of credits) and smaller second year exams seems to be a "winning strategy". Similarly, a regular class attendance is positively associated with the students' grade point averages and with the probability of graduating in time. Internships have a negative impact on grades but they are positively associated to shorter academic careers. These findings have important policy implications: policy makers

interested in improving academic achievements both in terms of grades and excess time to degree should enforce students to follow a more regular academic path especially regarding the timing and the sequence of passing the scheduled exams. Regarding the external economic conditions in the labor market, we find that higher sectoral unemployment rate for graduates are associated with longer academic careers.

Our theoretical model suggests that there is an inverse relationship between grades and time to graduation. While there is an unambiguous effect of students' ability and financial condition on grades, these effects are less straightforward in the case of time to graduation. The impact of ability and financial condition on time to graduation depends on students' academic track regularity. Moreover, for any given level of income and ability, an increase in time spent on working or other extra-curricular activities decreases both grades and time savings. The predictions of the model were then tested in the context of a two stage estimation procedure where grades and time to graduation were instrumented with several individual-specific and macro-economic variables. The empirical results confirm the predictions of the model.

6 Appendix A: Additional Regression Tables

Table 5: *Results From the* ***Truncated Regression Estimation*** *of the Determinants of Academic Performance: Final Grade (2004 - 2012)*

Variable	**Model 1** Coeff./SE	**Model 2** Coeff./SE	**Model 3** Coeff./SE	**Model 4** Coeff./SE	**Model 5** Coeff./SE	**Model 6** Coeff./SE	**Model 7** Coeff./SE
Gender	0.286	0.326	-0.195	-0.015	-0.184	-0.194	-0.184
	0.216	0.219	0.183	0.207	0.183	0.183	0.183
Age at Enrollment	0.385***	0.375***	0.552***	0.558***	0.548***	0.549***	0.550***
	0.071	0.074	0.067	0.073	0.067	0.067	0.067
High School Grade	0.565***	0.558***	0.384***	0.500***	0.383***	0.383***	0.381***
	0.010	0.010	0.008	0.009	0.008	0.008	0.008
General Classic	7.911***	7.525***	5.706***	6.743***	5.693***	5.656***	5.661***
	0.418	0.427	0.351	0.391	0.350	0.349	0.349
General Scientific	6.388***	6.168***	4.416***	5.390***	4.396***	4.395***	4.414***
	0.243	0.252	0.210	0.237	0.210	0.210	0.210
General Linguistic	3.699***	3.604***	2.635***	3.029***	2.628***	2.603***	2.603***
	0.347	0.351	0.291	0.324	0.291	0.291	0.290
Professional	-3.806***	-4.039***	-2.276***	-3.891***	-2.300***	-2.312***	-2.305***
	0.538	0.553	0.466	0.521	0.464	0.464	0.462
Mother Univ. Degree		1.694***	1.233***	1.302***	1.208***	1.210***	1.225***
		0.376	0.313	0.347	0.313	0.313	0.312
Father Univ. Degree		0.665**	0.469*	0.334	0.484*	0.482*	0.465*
		0.325	0.270	0.303	0.269	0.269	0.269
Working Class		0.537*	0.474*	0.526*	0.488*	0.506**	0.508**
		0.312	0.258	0.291	0.258	0.257	0.257
Middle Class		0.455*	0.308	0.381	0.322	0.327	0.333
		0.257	0.210	0.238	0.210	0.210	0.210
Scholarship		1.651***	0.591***	1.227***	0.607***	0.602***	0.588***
		0.269	0.222	0.251	0.222	0.221	0.221
Credits 1st year			0.163***		0.159***	0.239***	0.231***
			0.007		0.007	0.016	0.016
Credits 2nd Year			0.131***		0.132***	0.089***	0.090***
			0.006		0.006	0.013	0.013
Average credits by exam 1st Year				1.233***	0.543***		
				0.133	0.112		
Average credits by exam 2nd Year				0.088	-0.287***		
				0.090	0.079		
Number Exams 1st Year						-0.438***	-0.388***
						0.080	0.081
Number Exams 2nd Year						0.241***	0.240***
						0.068	0.068
Credits Recognized			0.111***	0.069**	0.110***	0.106***	0.106***
			0.031	0.035	0.031	0.031	0.031
Credits "Debt"			-1.936***	-2.726***	-2.024***	-2.148***	-2.004***
			0.167	0.216	0.191	0.196	0.199
Erasmus			6.766***	6.518***	6.731***	6.715***	6.745***
			0.401	0.451	0.400	0.400	0.401
Attendance > 75%			1.519***	3.109***	1.498***	1.508***	1.496***
			0.182	0.197	0.181	0.181	0.181
Internship at Univ.			1.287***	1.234***	1.191***	1.268***	1.256***
			0.333	0.376	0.334	0.332	0.331
Internship not at Univ.			-0.005	-0.043	-0.010	0.022	0.036
			0.229	0.255	0.230	0.229	0.228
Occasional Jobs			-0.442**	-1.193***	-0.442**	-0.436**	-0.446**
			0.220	0.251	0.220	0.220	0.219
Workers			-1.817***	-3.190***	-1.790***	-1.761***	-1.797***
			0.438	0.482	0.436	0.435	0.434
PeerAbility							0.325***
							0.082
PeerIncome							7.070*
							4.090
Economics	-9.298***	-9.042***	-6.037***	-8.070***	-6.119***	-6.167***	-5.101***
Literature	7.386***	7.466***	8.792***	8.723***	8.982***	9.117***	10.284***
Science	-1.226***	-0.991**	2.112***	-1.369***	1.819***	1.919***	3.237***
N. Observations	13279	12807	12710	12710	12710	12710	12710

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Robust Standard Errors in parenthesis. Reference categories: Males, High Class, Residence in the South, Department of Languages. The residence dummy variables are not shown for the sake of space.*

Table 6: *Results From the* ***Truncated Regression*** *of the Determinants of Academic Performance: Time to Degree in Years (2004 - 2012)*

Variable	**Model1** Coeff./SE	**Model2** Coeff./SE	**Model3** Coeff./SE	**Model4** Coeff./SE	**Model5** Coeff./SE	**Model6** Coeff./SE
Gender	-0.463***	-0.428***	-0.035	-0.146***	-0.038	-0.036
	0.073	0.072	0.027	0.044	0.025	0.025
Age at Enrollment	0.179***	0.174***	0.033***	0.041***	0.031***	0.030***
	0.019	0.019	0.009	0.013	0.008	0.008
High School Grade	-0.084***	-0.081***	-0.005***	-0.043***	-0.006***	-0.006***
	0.004	0.004	0.001	0.002	0.001	0.001
General Classic	-0.968***	-0.904***	-0.138***	-0.428***	-0.115***	-0.123***
	0.117	0.117	0.041	0.068	0.038	0.039
General Scientific	-0.908***	-0.867***	-0.126***	-0.409***	-0.116***	-0.121***
	0.084	0.084	0.031	0.051	0.029	0.029
General Linguistic	-0.518***	-0.521***	-0.130***	-0.233***	-0.104***	-0.107***
	0.115	0.114	0.038	0.066	0.035	0.036
Professional	1.091***	1.071***	0.117*	0.707***	0.128**	0.138**
	0.165	0.163	0.065	0.107	0.062	0.062
Mother Univ. Degree		-0.048	-0.038	-0.012	-0.015	-0.017
		0.109	0.041	0.068	0.038	0.038
Father Univ. Degree		-0.133	-0.078**	-0.034	-0.070**	-0.068**
		0.100	0.036	0.061	0.034	0.034
Working Class		0.046	0.075**	0.076	0.074**	0.075**
		0.099	0.036	0.060	0.034	0.034
Middle Class		-0.023	0.052*	0.011	0.043	0.041
		0.080	0.030	0.049	0.028	0.028
Scholarship		-0.563***	-0.061**	-0.329***	-0.068**	-0.070**
		0.086	0.030	0.051	0.028	0.028
Credits 1st year			-0.050***		-0.041***	-0.056***
			0.001		0.001	0.002
Credits 2nd Year			-0.043***		-0.041***	-0.067***
			0.001		0.001	0.002
Average credits by exam 1st Year				-0.476***	-0.181***	
				0.040	0.021	
Average credits by exam 2nd Year				-0.569***	-0.191***	
				0.031	0.012	
Number Exams 1st Year						0.069***
						0.012
Number Exams 2nd Year						0.133***
						0.010
Av1st*Economics					-0.109***	-0.204***
					0.029	0.029
Av1st*Literature					-0.014	-0.032
					0.043	0.044
Av1st*Science					0.080***	-0.047**
					0.027	0.022
Credits Recognized			0.002	0.025***	0.008*	0.007
			0.004	0.006	0.004	0.004
Credits "Debt"			0.316***	0.701***	0.467***	0.473***
			0.030	0.053	0.030	0.031
Erasmus			-0.107**	0.150**	-0.101**	-0.108**
			0.044	0.066	0.042	0.042
Attendance > 75%			-0.225***	-0.819***	-0.197***	-0.199***
			0.027	0.044	0.025	0.025
Internship at Univ.			-0.062	-0.112	-0.113***	-0.101**
			0.044	0.071	0.040	0.040
Internship not at Univ.			0.084***	-0.004	0.013	0.024
			0.032	0.052	0.030	0.030
Occasional Jobs			0.148***	0.528***	0.133***	0.142***
			0.027	0.053	0.025	0.026
Workers			0.812***	1.434***	0.733***	0.758***
			0.077	0.105	0.070	0.071
Foreign Residence			0.235	0.453	0.243	0.244
			0.264	0.419	0.235	0.241
Unemployment rate			0.022***	0.211***	0.090***	0.086***
			0.006	0.013	0.007	0.007
PeerAbility						-0.037***
						0.012
PeerIncome						-1.432***
						0.503
Economics	0.832***	0.773***	-0.089*	1.840***	0.995***	1.331***
Literature	0.582***	0.545***	-0.364***	-0.020	-0.360*	-0.389*
Science	1.585***	1.483***	0.047	2.742***	0.274	0.711***
N. Observations	13279	12807	12710	12710	12710	12710

7 Appendix B: Figures

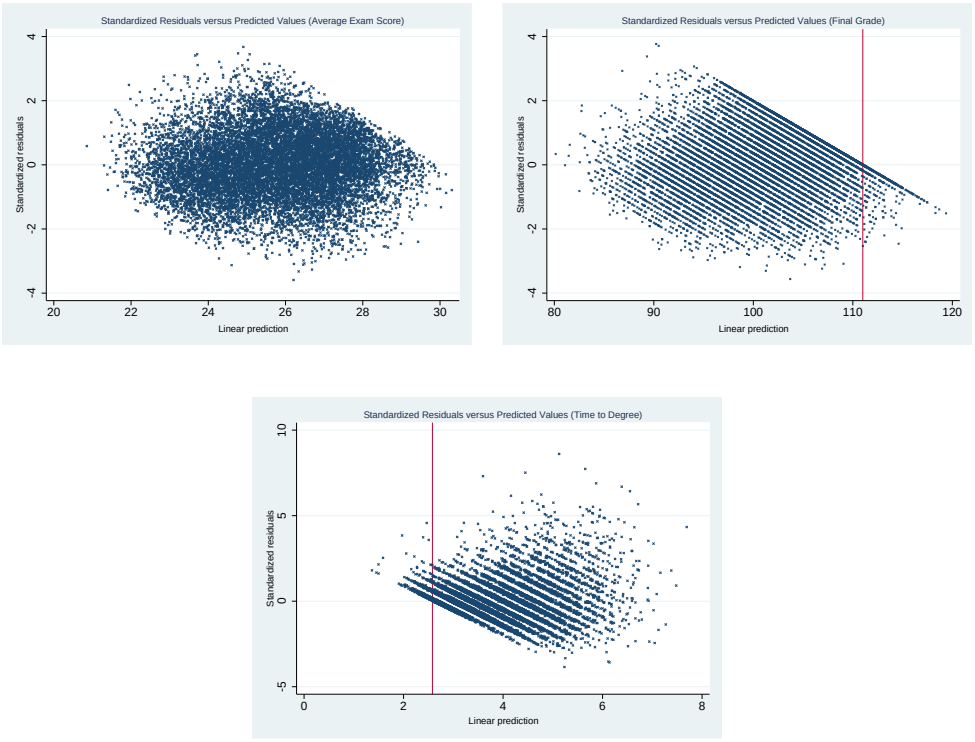

Figure 1: Standardized residuals versus predicted values for GPA, Final Grade, and TTD, 2004 - 2012.

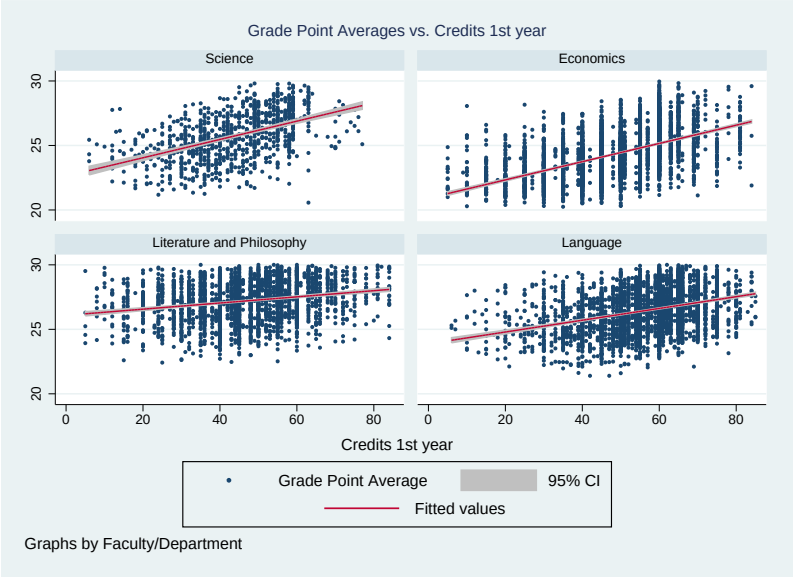

Figure 2: First year credits versus GPA by Faculty/Department: 2004 - 2012.

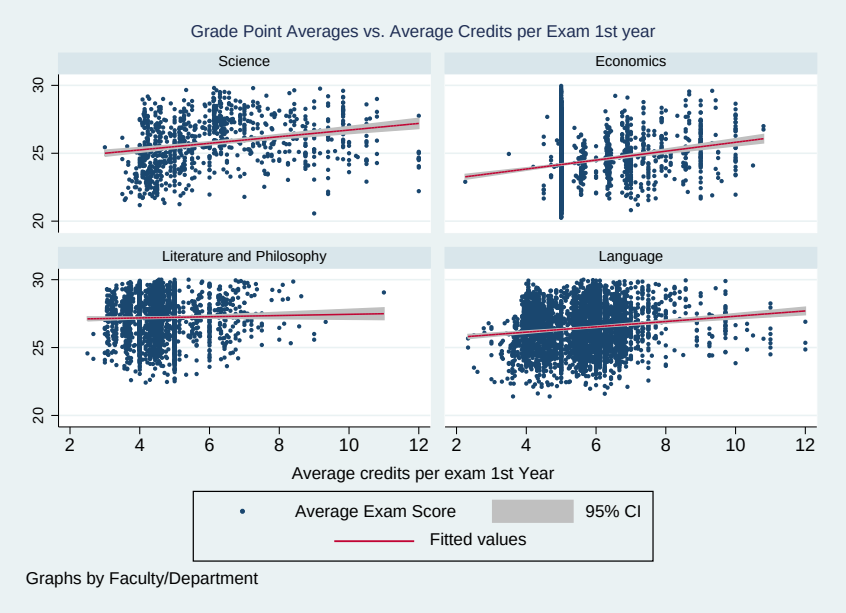

Figure 3: Average number of the first year credits versus GPA by Faculty/Department: 2004 - 2012.

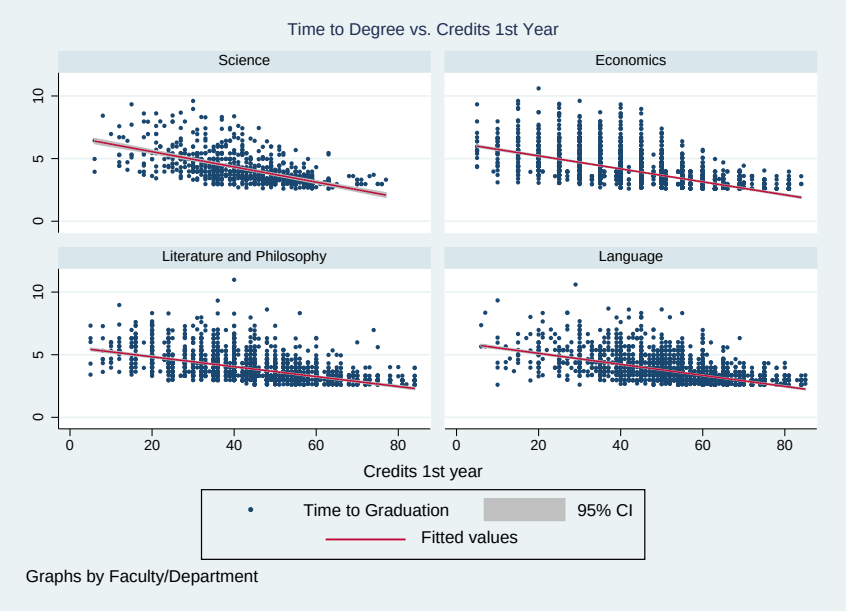

Figure 4: First year credits versus TTD by Faculty/Department: 2004 - 2012.

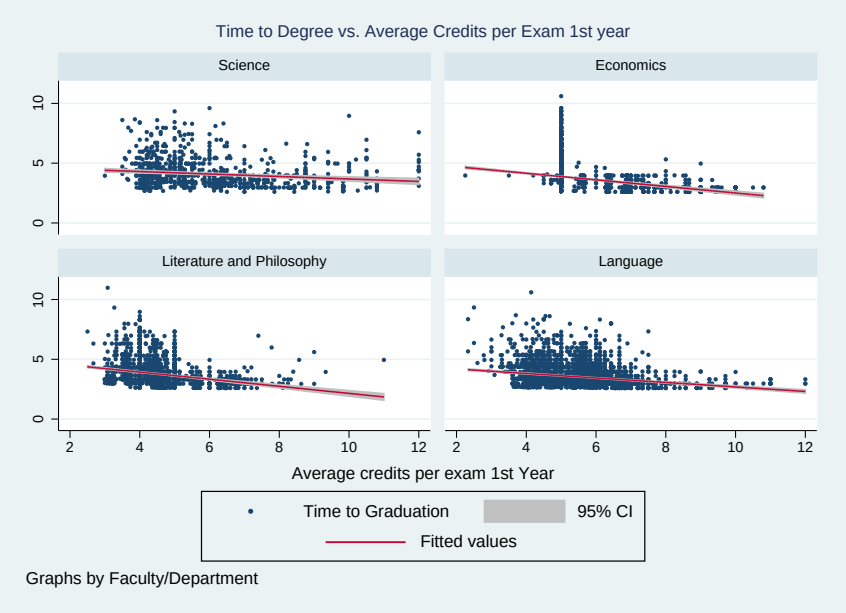

Figure 5: Average number of the first year credits versus TTD by Faculty/Department: 2004 - 2012.

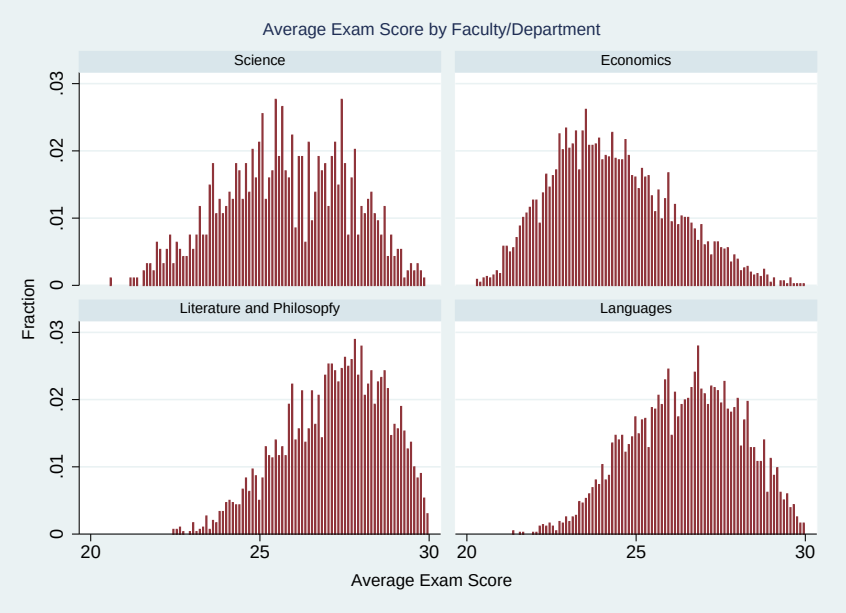

Figure 6: Distribution of average exam grades by department: 2004-2012.

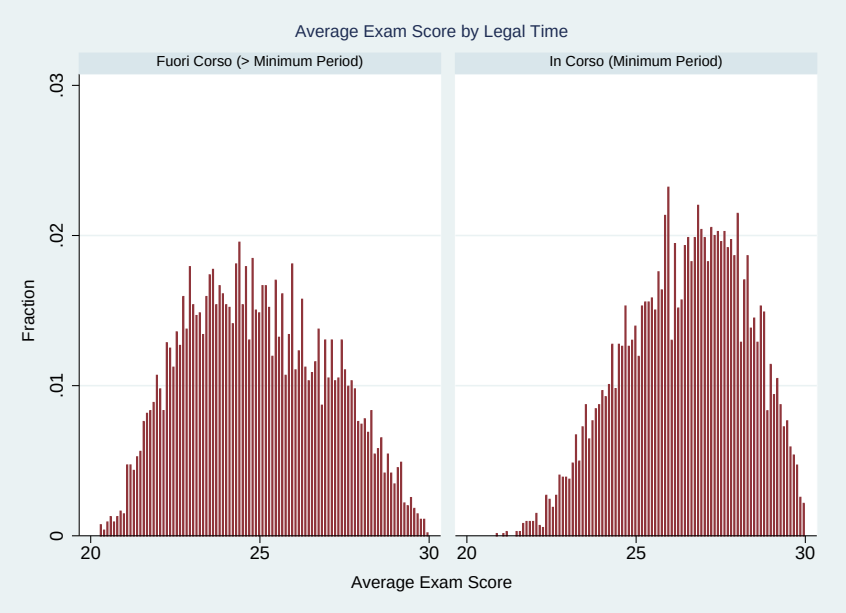

Figure 7: Distribution of average exam grades by "In Corso" issue: 2004-2012.

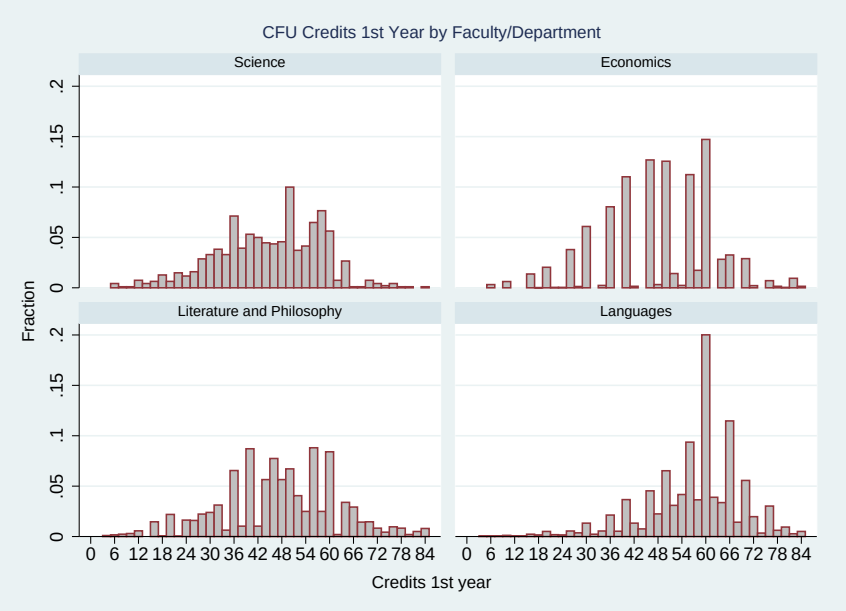

Figure 8: Distribution of 1st year Credits by Department: 2004 - 2012.

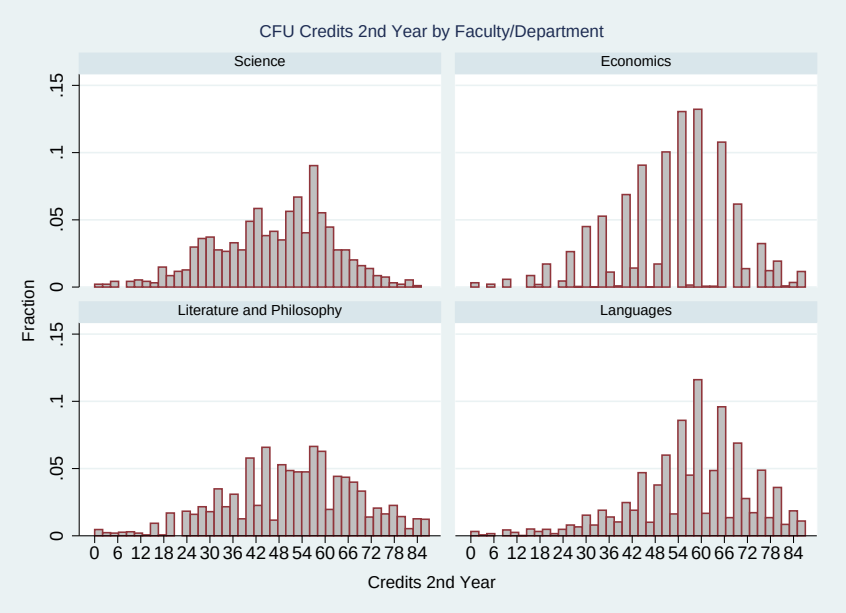

Figure 9: Distribution of 2nd year Credits by Department: 2004 - 2012.

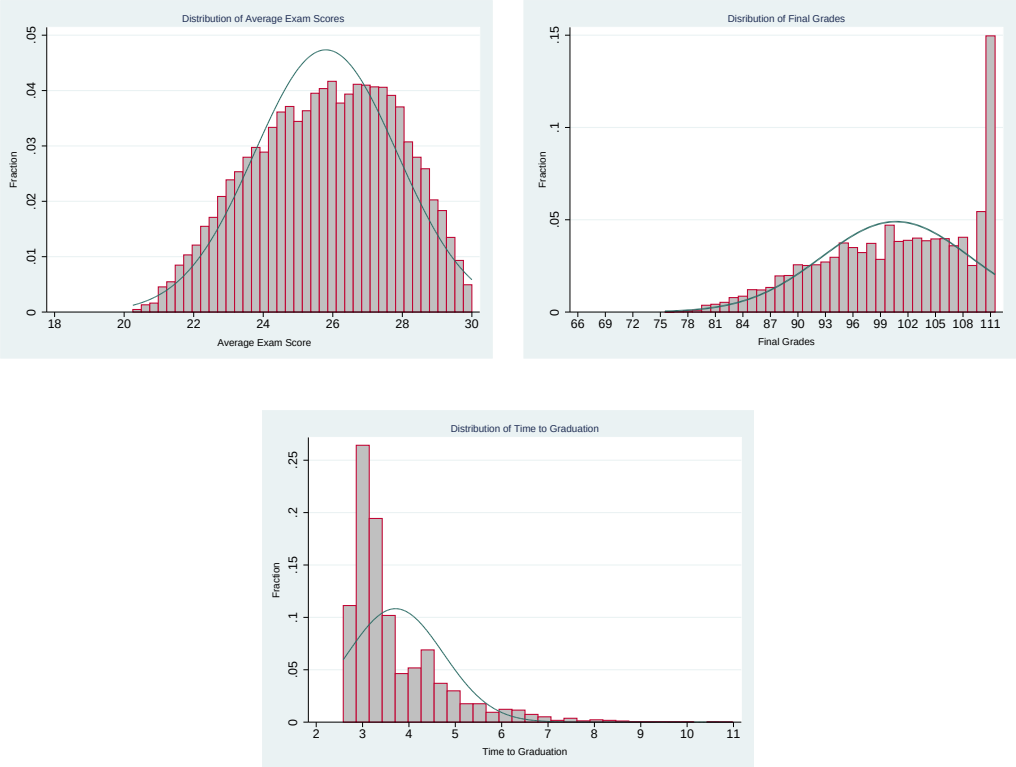

Figure 10: Distribution of Average Exam Scores, Time to Degree and Final Grades.

8 Appendix C: Summary Statistics

Table 7: Summary statistics : 2004 - 2012

Variable	Mean	Std. Dev.	Min.	Max.	N
Dependent Variables					
Average Exam Score	25.746	2.058	20.25	30	13279
Time to Graduation	3.767	1.093	2.584	10.984	13279
Final Grade	100.699	8.144	76	111 (110*cumLaude*)	13279
Delay	0.518	0.936	0	7.501	13279
Minimum Time ("In Corso")	0.556	0.497	0	1	13279
Personal and Family Characteristics					
Gender	0.692	0.462	0	1	13279
Foreigner	0.016	0.124	0	1	13279
Mother Univ. Degree	0.129	0.335	0	1	12918
Father Univ. Degree	0.166	0.372	0	1	12884
High Class	0.243	0.429	0	1	13279
Working Class	0.225	0.418	0	1	13279
Middle Class	0.503	0.5	0	1	13279
Not Classifiable	0.024	0.152	0	1	13279
Scholarships	0.216	0.411	0	1	13047
Academic Experience prior to Univ.					
High School Grade	82.702	12.174	60	100	13279
General Classic	0.128	0.334	0	1	13279
General Scientific	0.291	0.454	0	1	13279
General Linguistic	0.137	0.343	0	1	13279
Professional	0.032	0.175	0	1	13279
Technical	0.339	0.473	0	1	13279
Other general	0.064	0.245	0	1	13279
Other High School	0.005	0.072	0	1	13279
Foreign High School	0.005	0.068	0	1	13279
Academic Experience					
Age at Enrollment	19.306	1.595	17	35	13279
Credits 1st Year	49.813	13.995	5	85	13279
Credits 2nd Year	53.019	15.848	5	85	13279
Exams 1st Year	9.604	2.762	1	16	13279
Exams 2nd Year	9.908	3.311	1	17	13279
Credits per Exam 1st Year	5.299	1.18	2.25	12	13279
Credits per Exam 2nd Year	5.584	1.54	2.5	13.2	13279
Credits Recognized	0.716	3.366	0	39	13279
Credits "Debt"	0.448	0.497	0	1	13279
Erasmus	0.077	0.267	0	1	13279
Frq. $< 25\%$	0.022	0.146	0	1	13049
Frq.between 25% and 50%	0.05	0.218	0	1	13049
Frq.between 50% and 75%	0.183	0.387	0	1	13049
Frq. $> 75\%$	0.745	0.436	0	1	13049
Duration Thesis Elaboration	3.199	2.229	0	24	13276
Economics	0.366	0.482	0	1	13279
Literature and Philosophy	0.228	0.42	0	1	13279
Languages	0.331	0.471	0	1	13279
Sciences	0.074	0.262	0	1	13279

Table 8: Summary statistics : 2004 - 2012

Variable	Mean	Std. Dev.	Min.	Max.	N
Internships and Work Experience					
Internship	0.668	0.471	0	1	13212
Internship Univ.	0.11	0.313	0	1	13212
Internship not at Univ.	0.558	0.497	0	1	13212
Occasional Jobs	0.766	0.423	0	1	13028
Workers	0.041	0.198	0	1	13028
Peer Group Effects					
Peer Effect: Ability (High School Grade)	82.785	1.636	78.307	86.034	13279
Peer Effect: Family Income (Scholarship)	0.216	0.041	0.129	0.277	13047
Peer Effect: Mother Univ.	0.129	0.035	0.053	0.19	12918
Peer Effect: Father Univ.	0.166	0.031	0.053	0.238	12884
Mobility					
Resident North-East	0.917	0.276	0	1	13279
Resident North	0.052	0.222	0	1	13279
Resident Center	0.013	0.115	0	1	13279
Resident South	0.015	0.121	0	1	13279
Resident Foreign	0.002	0.05	0	1	13279
not all foreigners included here					
Same Province	0.342	0.474	0	1	13279
Other Province/Same Region	0.507	0.499	0	1	13279
Other Region	0.147	0.355	0	1	13279
Labor Market Conditions					
Unemployment Rate (per sector)	13.94	4.175	4.6	23.3	13279

Table 9: Summary Statistics: Distribution of graduates - GPA and TTD

	On-Track ≥ 27	On-Track < 27	Out-of-Track ≥ 27	Out-of-Track < 27
High School Grade	89.4	83.12	83.9	77.7
Credits 1st	58.7	55.7	42.79	40.36
Credits 2nd	61.26	59.9	44.22	43.49
Father Univ. Degree (%)	19.7	14.5	22.6	15.2
Mother Univ. Degree (%)	17.3	10.8	19	10.6
Scholarship (%)	26.6	22.3	23.28	17.3
Attendance (%)	88	82.3	65.9	60.7
Erasmus (%)	11.3	5.3	12.3	6.6
General Classic (%)	22.9	8.9	23.07	7.5
General Scientific (%)	29.43	29.45	28.98	28.48
General Linguistic (%)	19.13	13.5	14.2	10.1
Professional (%)	1.5	2.85	4.91	4.08

Table 10: Cross-correlation table: **Average Exam Score**

Indicator Regularity	Exam Score	Credits 1st	Credits 2nd	Exams 1st	Exams 2nd	Credits/ Ex.1st	Credits/ Ex.2nd
Exam Score	1.000						
Credits 1st	**0.370**	1.000					
Credits 2nd	**0.271**	0.407	1.000				
Exams 1st	**0.363**	0.743	0.303	1.000			
Exams 2nd	**0.218**	0.166	0.776	0.428	1.000		
Cr./Ex. 1st	**0.037**	0.340	0.147	-0.333	-0.332	1.000	
Cr./Ex. 2nd	**0.073**	0.347	0.159	-0.167	-0.452	0.691	1.000

Table 11: Cross-correlation table: **Time to Graduation**

Variables Regularity	Duration (in years)	Credits 1st	Credits 2nd	Exams 1st	Exams 2nd	Credits/ Ex.1st	Credits/ Ex.2nd
Duration	1.000						
Credits 1st	**-0.602**	1.000					
Credits 2nd	**-0.593**	0.407	1.000				
Exams 1st	**-0.460**	0.743	0.303	1.000			
Exams 2nd	**-0.400**	0.166	0.776	0.428	1.000		
Cr./Ex. 1st	**-0.212**	0.340	0.147	-0.333	-0.332	1.000	
Cr./Ex. 2nd	**-0.242**	0.347	0.159	-0.167	-0.452	0.691	1.000

Table 12: Cross-correlation table: **"OnTrack"**

Variables Regularity	"OnTrack" (dummy)	Credits 1st	Credits 2nd	Exams 1st	Exams 2nd	Credits/ Ex.1st	Credits/ Ex.2nd
"OnTrack"	1.000						
Credits 1st	**0.574**	1.000					
Credits 2nd	**0.529**	0.407	1.000				
Exams 1st	**0.447**	0.743	0.303	1.000			
Exams 2nd	**0.359**	0.166	0.776	0.428	1.000		
Cr./Ex. 1st	**0.185**	0.340	0.147	-0.333	-0.332	1.000	
Cr./Ex. 1st	**0.201**	0.347	0.159	-0.167	-0.452	0.691	1.000

Table 13: Cross-correlation table: **Indicators Performance**

Indicators Performance	Exam Score	Time to Graduation	"OnTrack" (dummy)	Excess Time
Exam Score	1.000			
Time to Graduation	**-0.361**	1.000		
"OnTrack"	**0.368**	-0.721	1.000	
Excess Time	**-0.316**	0.974	-0.620	1.000

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