UNIVERSITY DROPOUT IN ITALY

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Abstract

Student dropout rates are a longstanding issue in Italian universities. The number of students who graduate is traditionally around 30 per cent of students who enroll for the first year of a university course. This outcome is considered an indicator of low performance of Italian universities.

The literature shows that after the 2001 reform of the university system, dropout probability is lower. It is also argued that the reform had a significant impact on students' motivation to complete a university degree. However, empirical analyses are still limited.

The aim of this work is to carry out an analysis of Italian university dropouts, by focusing on the supply side of university education. The argument put forth in this paper is that higher students dropout rates may be explained by structural and organizational characteristics of each university (such as number of courses) rather than by students' personal motivations only. This would imply that a better reorganization of university courses might allow to achieve a lower number of drop-outs and, overall, a better performance of Italian students.

In our study, the dependent variable selected for the analysis is the number of dropouts both for university students who enroll for the first time and all other university students, proxied by the number of students who did not obtain any university credit (cfu). Explanatory variables are related to supply (such as number of degree courses, number and location of decentralized branches for each university); postgraduate opportunities (PhD courses); students background (such as type of high school attended before university enrollment, average marks).

Italian universities have been observed since the implementation of the reform. A common feature related to cross sectional time series data is unobserved heterogeneity, i.e. the possibility of unobserved time invariant effects due to each unit: for example, some universities, in spite of efforts to overcome some structural weaknesses, might maintain a reputation which is not aligned to the current quality of service. Hence, a fixed effects model has been selected.

The analysis shows which factors, among those considered, have a higher impact on students dropouts: courses taught in decentralized branches appear to be particularly significant, especially for new enrolled students. Our analysis also suggests that universities with decentralized branches have a relevant impact on dropouts; therefore, corrective measures should point at the reorganizing of universities with branches located in peripheral areas.

JEL: *I23, C33, H52*

1.- Introduction

University dropout in Italy has been a widely observed and documented phenomenon for many years. A large number of Italian students, compared to their OECD counterparts, leave university before completing their degree courses. Only about one third of students who enrol get a university degree; most of the others drop out before moving on to the second year (after enrolment), and some of the remaining students abandon their course later on. Moreover, Italian students who graduate tend, on average, to be slower than other OECD students in completing their degree courses (for recent reports, see MIUR 2011; Regini 2009).

A large body of international literature exists on dropout issues; for instance, Mackie (2001), Smith and Naylor (2001), Bennett (2003), Harrison (2006) and Nao (2007) propose analyses of dropouts with regard to Anglo-Saxon universities. However, only a relatively small number of papers exists on the Italian case, notwithstanding the historically low performance of Italian students. Most studies on dropouts in Italy have been conducted after a reform introduced from the academic year 2001-02; those studies focus on analyses of data about students' enrolment numbers and payments (especially fees) with regard to individual universities (for instance, Schizzerotto 2003; Broccolini and Staffolani 2005).

The aim of our study is to investigate university dropouts in Italy, taking a broader perspective compared to existing contributions on the Italian case and considering jointly two relevant dimensions for analysis, that is, the 'university' dimension and the 'student' dimension. With regard to scope of our analysis, this study takes into account all Italian universities, including both public and private with the exclusion of telematic Universities, as their nature and structure is different from the traditional ones; in addition, they have only a relatively short history and data are, therefore, limited. With regard to relevant dimensions, this study intends to highlight elements related to the organizational structure of degree courses supplied by Italian universities - such as numbers of degree courses for each university, of decentralised teaching branches, of teaching staff (that is, a 'university' dimension) – besides elements related to subjective characteristics of university students – such as performance in previous educational stages, background (that is, a 'student' dimension, which has been more commonly considered in the literature about university dropouts).

The crucial hypothesis this work intends to test is whether first year university students dropouts are due to elements related to organizational structures of degree courses in individual universities rather than (only) characteristics of the students population.

Therefore the remaining of this paper is organized as follows. Section 2 provides a short literature review of contributions regarding dropout rates, focussing on recent developments in Italian universities. Section 3 gives an overview of the Italian university system using quantitative data to highlight some key changes which have occurred in recent years. Section 4 moves on to econometric analyses – based on estimations of a fixed effects model - and illustrates methodology applied. Major results of our analyses and comments to results are in Section 5. Section 6 concludes and provides policy suggestions.

2.- Literature review

University dropout rates have been capturing attention by researchers (as well as by commentators and policy makers) for years. This has produced a fair amount of dropouts analyses, which have taken a number of directions. Some studies have posed the question whether low dropout rates are socially desirable. Different results have been published in the literature answering questions of that kind: on the one hand, results obtained by some authors suggest that it is socially desirable to have students who complete their degree courses (therefore, dropouts should be avoided); on the other hand, some authors argue that public policies should not try to influence dropout rates, as trying to reduce those rates (i.e. the number of university students who do not complete their degree courses) may be socially undesirable, for it could reduce social welfare. For instance, students may rationally choose not to complete their studies when they see better opportunities in the job market (for a brief review of this part of the literature, see Montmarquette *et al*. 2011).

The relatively high level of dropout rates calculated for Italian university students, especially in comparisons with students in other OECD countries (see, for instance, the two most recent OECD reports, 2009 and 2010), is analyzed in various contributions which share more closely our concern. Those contribution may be grouped with regard to two different approaches chosen for analysis: part of them studies dropout rates across the entire Italian university system and, in defining the scope of the analysis, focus on a relatively small group of variables, usually referred to students personal characteristics; another part of that literature chooses a narrower scope, as considers single Italian universities (quite often those studies are motivated by informational purposes emerged inside a single university).

Studies taking the first (broad) approach include Di Pietro and Cutillo (2008), who examine the impact of various ministerial measures introduced in recent years on duration, structure and content of degree courses offered by Italian universities. Those measures have been widely debated, especially after 2001, when Italian degree courses were deeply changed by a reform which introduced a number of changes in their regulations. With the reform, university degree courses have become more flexible and more numerous; moreover, ‘short’ three-year degree courses were introduced, thus offering students a university degree after a relatively short period than in the past. The conclusions in the study by Di Pietro and Cutillo highlight that the 2001 ministerial changes have had a positive impact on dropout rates. In a previous study, Di Pietro (2004) suggested to analyze the determinants of dropouts by Italian students by using a bivariate probit model, and taking into account the absence, in most cases, of barriers to enrolment in Italian universities (i.e., the so-called ‘numerus clausus’).

Cingano and Cipollone (2007) combine individual and aggregate level data on students educational attainment. They use information on a representative sample of secondary school graduates and local university level education supply to show that family and educational background are relevant determinants of continuation probability. They also show that cross-country differences in students attainments are only partially explained by differences in students’ endowments (in comparable European countries).

A study by Becker (2001) points to a comparison between dropouts in Germany and Italy in a univariate decisional framework. The argument proposed is that German students and Italian students may be grouped differently, with relevant implications in the analysis of dropouts probabilities in the two countries. The author argues that Italian students who abandon university before graduation can be separated into two major groups: the first group includes students who have not chosen the most suitable university degree course (according students characteristics) and, therefore, they find it harder to successfully complete their degree courses; the second group includes students who have enrolled to a university course only because they have not found a job yet (those students will dropout as soon as they receive a suitable job offer). In Germany, only students of the first group could be found; moreover, those students would be less than in Italy.

Published work concerned with dropout rates in individual Italian university is quite limited. In a recent paper, Belloc *et al*. (2010) study university dropouts in Italy using data from the School of Economics of “Università di Roma La Sapienza”. Their results show that high dropout probability is related to high secondary school graduation marks and low performance at university, suggesting that dropouts would reveal a dissatisfaction of those students with regard to the university degree chosen. Moreover, their empirical investigation shows a statistically significant impact of students characteristics such as nationality and income on dropouts.

A study by Schizzerotto (2003) analyzes dropouts from “Università di Milano Bicocca”. Results highlight factors which bear on dropout probability more than others; the author finds that age of students at the time of enrolment, secondary school educational background and graduation mark, as well as distance between the university and a student’s home are crucial factors. The study also shows that dropout probabilities are different across different Schools in the University (see also the study by Ugolini 2000); moreover, dropout probabilities show a decrease after academic year 2001-02, when the so called 3+2 reform has been implemented. Perotti (2008) criticizes the observation of lower dropout probabilities after 2001 and focuses on so called “quick graduates”, that is, students who have switched to ‘short’ degree courses after the 2001 reform (this increases artificially the number of students who completed their degree courses after 2001).

The impact on dropouts of the university degree reform introduced in 2001 is considered also in other studies which focus on individual universities. Boero *et al*. (2005) look at two universities (University of Cagliari and University of Tuscia) and find that the probability to complete a university degree course is highly influenced by differences in students educational background when they enter university. Broccolini and Staffolani (2005) look at the case of the School of Economics of “Università Politecnica delle Marche”. Their results show that students’ performances improve after 2001; however, they point out that the 2001 reform has also brought about a reduction in the effort required from students to complete their degree courses. Similar results are obtained also by D’Hombres (2007), who includes the motivational impact of the reform on students behavior: as a university degree can be obtained after a relatively shorter period than in the past, students would be more prone to complete their courses and graduate.

3.- The Italian university system

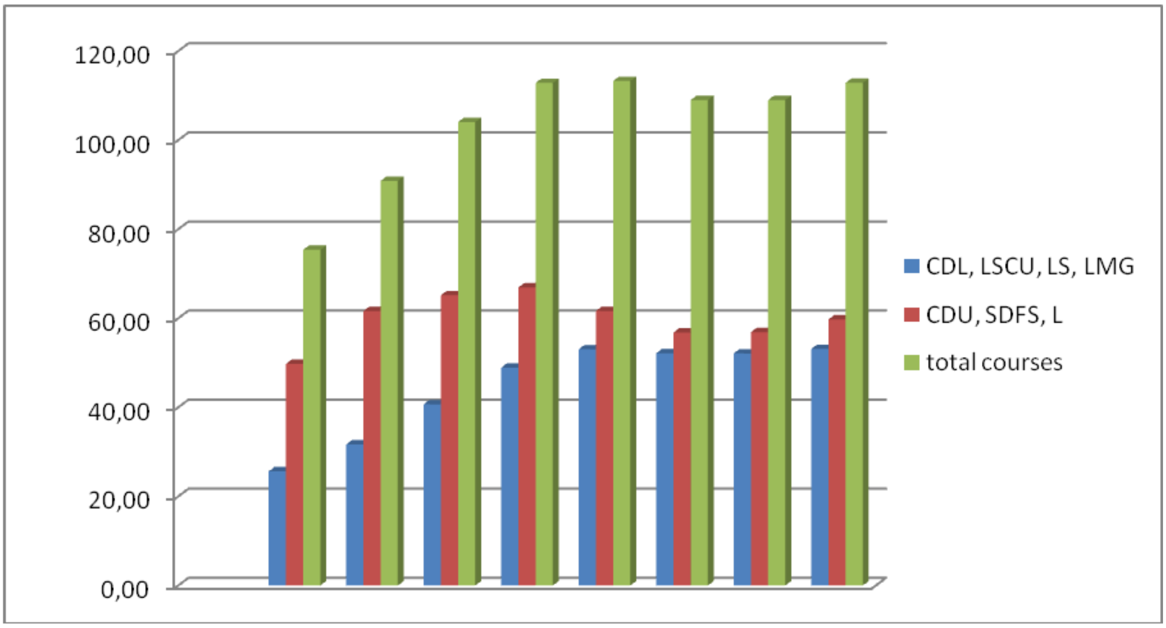
The Italian university system has gone through a number of legislative and regulatory changes in recent years. Those changes have partially re-shaped the system, which now consists of a greater number of public and private universities than in the past, as well as new telematic universities; moreover, for many years, the legislation has favoured a proliferation of degree courses offered throughout the Italian university system as well as an increase in the number of universities (and schools, including a few new ones), and their decentralised structures (mostly devoted to teaching activities rather than research activities). This has accompanied shifts in the demand for university level education, which has grown considerably (see, for instance, MIUR, 2011).

Changes in the legislation have brought about new types of degrees courses. Those courses can be grouped in ‘standard’ degree courses, which have a duration closer to traditional university degrees – usually five years – and ‘short’ degree courses, which are usually three-year degree courses; however, students are allowed to successfully complete their courses spending less time than the legal duration as long as they get the necessary amount of credits established for their degree. The first group of degrees includes ‘corsi di laurea quadriennale’ (CDL, a four-year degree course), ‘scuole di specializzazione’ (LSCU, a course in preparation for some specific profession or professions), ‘corsi di laurea specialistica’ (LS, usually a two-year degree completed after a ‘short’ degree course) and ‘corsi di laurea magistrale’ (LMG, a five-year degree); the second group includes ‘corsi di diploma universitario’ (CDU, which award university diploma) and ‘scuola diretta a fini speciali’ (SDFS, which has a nature similar to LSCU, but at a lower educational level).

The Italian “Ministero dell’Università e della ricerca scientific” (MIUR, i.e. Ministry of University and Scientific Research) publishes an annual report which provides information about the Italian system (*Rapporto sullo stato del sistema universitario*); moreover, the ministerial Department of statistics provides rich databases on Italian universities individually. Those sources of information are used here to give an overview of the Italian system, especially with regard to those variables which will be entered in the econometric model.

Figure 1 shows data about different kinds of degree courses and compares ‘standard’ degree courses with ‘short’ degree courses over the period chosen for our study (histograms refer to academic years 2001-02 to 2007-08).

Figure 1 – Number of university degree courses

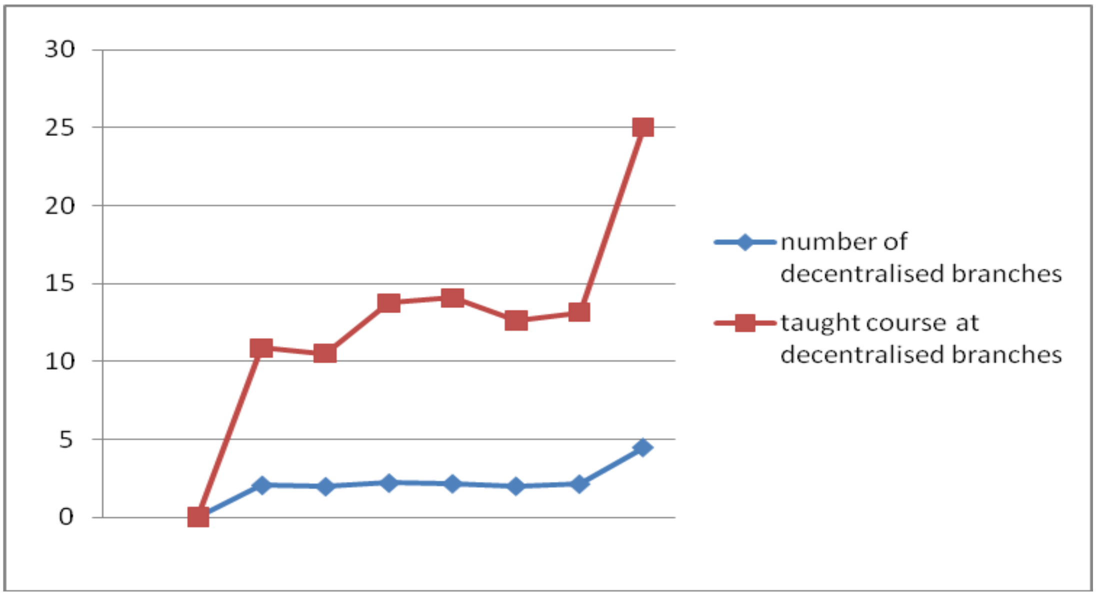


Source: elaborations based on MIUR data.

In the years immediately after the 2001-02 university reform, the number of ‘short’ degree courses has been increasing significantly. However, this number has been more stable afterwards, and has been accompanied by a slow but steady increase in the number of ‘standard’ degree courses (this has been influenced by the introduction of LMG courses only later on; in addition, in some cases, for instance LMG degrees awarded by Schools of Law, have a legal duration of four years instead of five).

Figure 2 shows together the number of decentralized university branches and the number of degree courses taught there over a time span of eight years. The number of degree courses taught in decentralized university branches has grown more than proportionally, compared to the number of decentralized branches itself. (In our discussion of the econometric estimates for our model, we argue that dropouts are influenced more by the variety in degree courses available in a decentralized university branch, than by dispersion of decentralized branches across the territory).

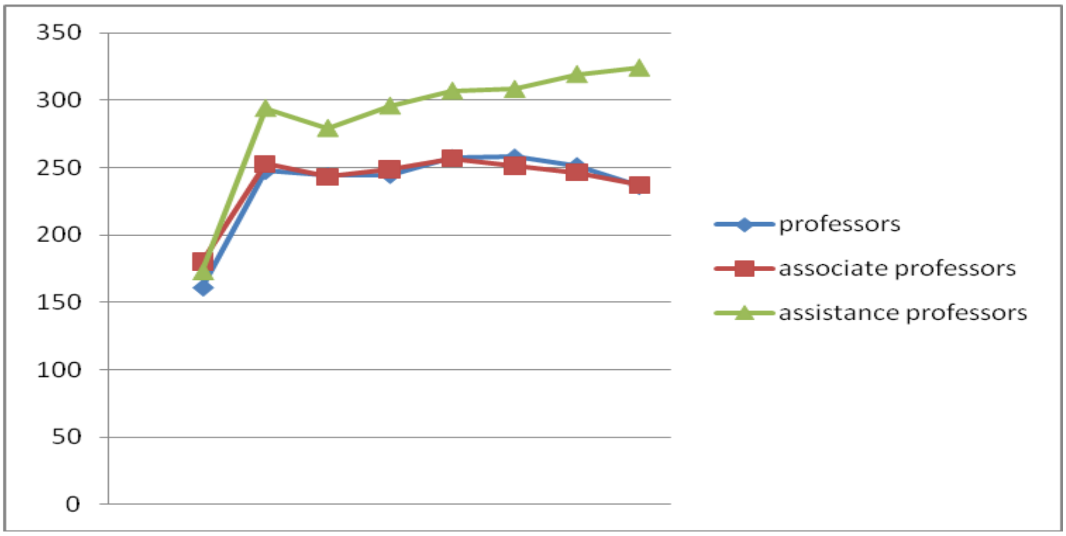
Figure 2 – Number of university branches and number of degree courses taught



Source: elaborations based on MIUR data.

Figure 3 provides an overview of the changes in the numbers of teaching staff, which includes full professors (‘professori ordinari’), associate professors (‘professori associati’), and assistant professors (‘ricercatori’). Figure 3 shows that the number of assistant professors has increased since 2004-05, while the numbers of full and associate professors have slightly declined, thus increasing the gap between different groups of teaching staff (however, teaching staff do not include, in our figures, professors teaching on an annual contract basis, which have been used quite often to teach courses in decentralised branches).

Figure 3 – Teaching staff



Source: elaborations based on MIUR data.

Table 1 shows historical data about the presence (and weight) of schools in Italian universities (on average). Some of them have grown significantly; for instance, the School of Communications sciences, which was almost a non existing one in 2001-02, can be found in 6% of Italian universities by 2006-07; similarly, the School of Statistics (considered independently from the School of Economics) was in 7% of universities by 2004-05. The School of Psychology has increased its presence steadily, as it was in 12,5% of universities in 2001-02 and has gone up to 22,1% by 2007-08; Engineering was in 37,5% of universities in 2001-02 and has been in half of them since 2004-05; a few new and emerging schools such as Biological sciences as autonomous schools have reached 6% in 2007-08. On the contrary, some schools have reduced their relative weight: for instance, the School of Sociology was in 87,5% of Italian universities in 2001-02 and is down to 71,3% in 2007-08 (a similar case happened with Economics). Moreover, as a further instance, Architecture has slightly decreased.

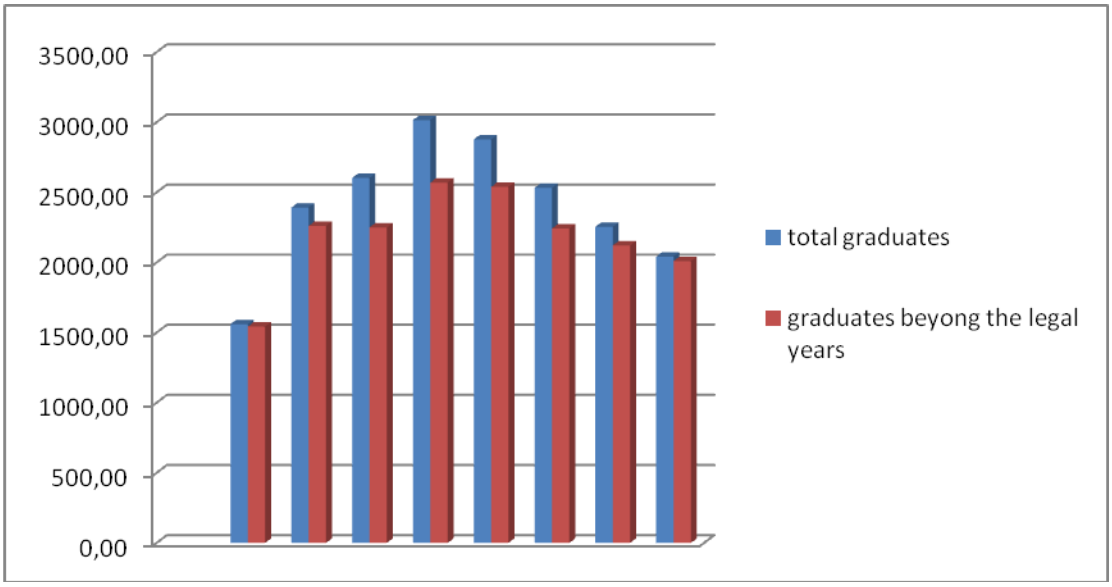
Table 1 – Schools in Italian universities and relative weight over time

School	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008
Agricultural studies	25,0%	31,5%	31,7%	31,1%	29,1%	27,7%	26,7%
Architecture	25,0%	27,4%	28,6%	27,0%	25,3%	24,1%	24,4%
Heritage studies	0,0%	2,7%	1,6%	2,7%	3,8%	4,8%	4,7%
Biological sciences	0,0%	4,1%	3,2%	4,1%	5,1%	6,0%	5,8%
Chemistry	0,0%	1,4%	0,0%	1,4%	1,3%	1,2%	1,2%
Design	12,5%	1,4%	1,6%	2,7%	3,8%	3,6%	4,7%
Economics	87,5%	73,0%	73,4%	72,0%	71,3%	71,4%	71,3%
Pharmacology	25,0%	39,7%	39,7%	39,2%	36,7%	35,4%	34,1%
Law	62,5%	68,5%	73,0%	68,9%	69,6%	71,1%	70,9%
Engineering	37,5%	55,6%	53,2%	54,8%	52,6%	51,2%	50,6%
Literature and philosophy	75,0%	61,6%	63,5%	62,2%	60,8%	57,8%	57,0%
Foreign languages and literature	62,5%	27,4%	27,0%	27,0%	26,6%	25,3%	25,6%
Medicine	42,9%	52,8%	54,8%	52,1%	48,7%	47,6%	45,9%
Psychology	12,5%	13,7%	15,9%	16,2%	19,0%	20,5%	22,1%
Environmental studies	12,5%	2,7%	3,2%	2,7%	2,5%	2,4%	1,2%
Communications studies	0,0%	5,5%	6,3%	5,4%	5,1%	6,0%	5,8%
Education	50,0%	37,0%	36,5%	35,1%	35,4%	36,1%	38,4%
Mathematics/Physics/Biology	75,0%	60,8%	62,5%	60,0%	56,3%	53,6%	50,6%
Sports sciences	12,5%	12,9%	15,0%	15,5%	14,5%	13,8%	13,3%
Political sciences	25,0%	42,5%	42,9%	41,9%	40,5%	39,8%	39,5%
Statistics	0,0%	6,8%	6,3%	6,8%	6,3%	6,0%	5,8%
Sociology	25,0%	6,9%	11,3%	11,0%	10,3%	9,8%	10,6%
Veterinary science	12,5%	19,2%	19,0%	18,9%	17,7%	16,9%	16,3%
Other	0,0%	5,4%	4,3%	9,1%	10,3%	11,5%	11,1%

Source: elaborations based on MIUR data

Last, but not least, Figures 4 and 5 show data about the performance of Italian students; their performance is lower than those of their foreign counterparts. The number of students who graduate beyond the legal period established to complete their degrees has been very close to the number of students who graduate in recent years (however, the number of additional years, beyond the legal is not specified).

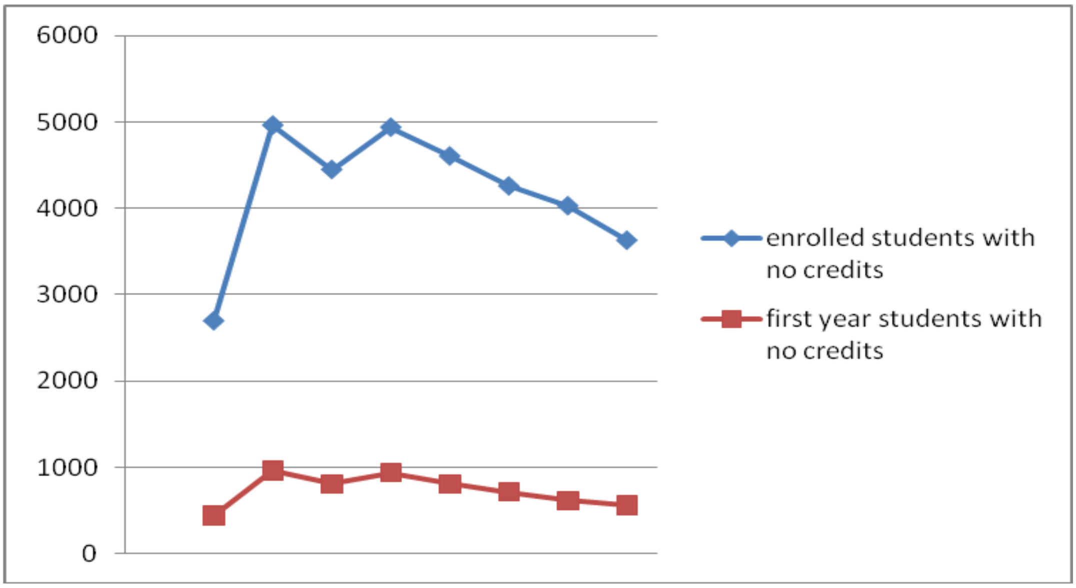
Figure 4 – Number of students who graduate (beyond the legal time limit)



Source: elaborations based on MIUR data.

The number of students who have not earned any learning credits by the end of their first academic year after enrolment is also noteworthy, especially with regard to our analysis. The number of university students who are inactive (they have not earned learning credits for some time, and have been therefore stuck in their university career) tends to decrease; nevertheless, the reduction in the number of first year students who do not get credits is of small proportion.

Figure 5 – Enrolled and continuing students who have gained no credits



Source: elaborations based on MIUR data.

A few tentative and intuitive hypothesis could be proposed with regard to this; for instance, this might be interpreted as the impact of an existing gap between what universities offer to their (potential students) and what students expect universities to be like at the time of enrolment (or later on). These kinds of issues are the focus of our analysis below.

4.- Methodology

Our analysis is focused on enrolled university student dropouts. Such phenomenon, when it is not determined by students' personal reasons, might signal a general dissatisfaction towards educational supply provided by universities (Becker 2001; Belloc *et al*. 2010) and require action to modify educational supply itself. Since the focus is on individual universities as observed units, the estimation strategy selected is a fixed effects model, in order to isolate the effects due to the characteristics of each university (Hsiao 1986; Arellano 2003; Allison 2009). Fixed effects model allows to solve the problem of heterogeneity, due to university characteristics that are not going to change with time, by including an error terms assumed to be constant across time.

The model specification is the following:

$$Y_{ij} = (\alpha + \delta_i) + X_{ij}\beta + \varepsilon_{ij}$$

The deterministic part of the equation is compounded by the constant term and an element δ varying for each unit. δ_i can be interpreted as "university effect", and ε_{it} is the residual term. The estimator has been obtained by applying OLS to a "transformed" model, that takes into account mean deviation.

When performing hierarchical analyses, the fixed effects model is particularly well suited if the main interest is a policy relevant inference analysis considering individual characteristics, and data selection process is not clear. Instead, when information about the selection process is available (e.g. the proportion of students with higher final marks at completion of higher school education and enrolling in some universities/schools, etc.) the random effects model should be selected (Clarke *et al.* 2010).

The regression coefficients and the university effect can be interpreted as policy relevant effects with further assumptions:

(*i*) $\varepsilon_{ij} \sim$ i.i.d. $N(0, \sigma^2_e)$ that is the 'normality assumption' and (*ii*) exogeneity of the covariates x_{ij}, e.g. cov (e_{ij}, x_{kij}) = 0 for $k = 1,\dots, p$ that is the 'regression assumption'.

While the 'normality assumption' (*i*) is desirable for reasons of estimator performance and interpretation, it is not essential for either the random or fixed effects approaches and we need only to assume that Var (e_{ij}) = σ^2_e. Instead, assumption (*ii*) is crucial to ensure that the regression coefficient has a policy-relevant interpretation.

Random effects models are more efficient because they generate narrower confidence intervals comparing to fixed effects models. However, their use requires that the error term must be uncorrelated with all the elements represented by the covariates x_{ij}. This is often referred to as the 'random effects assumption' and implies that unobserved characteristics of the university that might influence dropout, such as, for example, teaching quality, are not correlated with other elements that are included in the model. This assumption might easily fail. A reason is the non random selection of students into universities: if the university accepts students from the population at random, then the 'random effects assumption' would hold. In reality, a non random selection could operate, through which students choose university and the universities select which students to accept (this happens when students are selected on the basis of their CV and educational background). Hence, the probability of selecting a particular university varies systematically according to a series of factors that may also be associated with students' performance (in our case, the circumstance that students achieved credits).

To overcome this problem, a further set of covariate adjustments should be added to the model (considering both university supply factors, that is, our 'university' dimension, and student demand factors, that is, our 'student' dimension). However, since the choice of such variables should be driven by knowledge of the selection mechanisms, further difficulties may arise in the modeling exercise because the selection mechanism might not be totally understood and perfect measures of all factors are rarely available.

In the fixed effects model, often called the "within" estimator because it is based on deviations of x_{ij} and y_{ij} from their group (in this case, from their university), no assumptions are made about the error term, so that the university effects are treated as nuisance. However, this implies that the research questions that can be explored using a fixed effects approach are limited.[1]

[1] Moreover, the estimates with fixed effects approach are not precisely weighted and can be very unreliable where n_j is small or the within universities is large relative to between universities variance. Wooldridge (2002) emphasizes, by making a comparison between fixed and random effects approaches, how the two estimators are not equal, but in some cases can be very close (for example, when the number of students is large or when between school variation is large relative to within school variation).

Overall, the choice of fixed or random effects should be dominated by background knowledge and the type of available data (Greene 2002).[2]

The database used in the analysis includes MIUR[3] and ISTAT[4] data, related to 76 Italian universities with the exclusion of telematic universities that offer distance learning. The observation period considers, for each university, the time span between the implementation of the 2001 reform (which introduced a profound change with 3+2 degree courses) and the academic year 2007-08 (the lastest available information in the database). The university panel is unbalanced; the greatest part of the universities presents 7 observations, while some of them (e.g., Bolzano, Cagliari, Catanzaro) have implemented the reform in academic year 2001-02 and hence present 8 observations.

5.- Results

Descriptive statistics related to the variables employed in the analysis can be seen in Table 2.

Table 2 – Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Public/private universities	537	.8640596	.3430448	0	1
University and type of courses					
Number of decentralized branches	465	4.116129	4.600817	0	27
Number of sites in the same province	464	.5711207	.4954502	0	1
Number of sites outside the province	464	.6551724	.475825	0	1
3 year courses	464	50.06466	42.95319	1	257
3 year courses including university diploma and SDFS	467	65.53319	56.46124	1	313
Total number of courses (including 4 year courses)	466	117.0773	98.9773	1	552
Courses taught in decentralized branches	506	22.06324	32.58068	0	211
3 year courses/total courses	463	.4426321	.1099364	.2	1
Doctoral courses	278	209.1151	201.9558	3	1053
Doctoral courses with scholarships	278	113.9029	111.1445	2	560
Teaching staff					
Professors	521	256.4453	271.6145	1	1471
Associate professors	522	251.9693	254.5403	1	1360
Assistant Professors	513	309.8577	342.3277	1	2065
Overall teaching staff	513	825.6335	862.2534	5	4817
Professors/teaching staff	513	.3170309	.0707793	.1333333	.6666667
Associate professors/teaching staff	513	.3214804	.059945	.1111111	.7272727

[2] Clarke *et al.* (2010) remind, however, how more flexible modeling strategies permitted by some random effects models can be used to offset failure of the random effects assumption. An obstacle is represented especially by the failure of regression assumption rather than the failure of random effects assumption.
We should wonder about what kind of results we expect to obtain from the analysis. Policy relevant inferences are causal inferences about average treatment effects: for example, we might consider the type of degree course, as well as a change in supply of courses, number of decentralized university branches, etc. and intervene to change the *ex ante* situation.
[3] http://statistica.miur.it/ustat/Statistiche/IU_home.asp
[4] http://www.istat.it/ambiente/contesto/infoterr/azioneB.html

Assistant professors/teaching staff	513	.3614887	.0861766	.0714286	.6428571
New enrolled students with no credits					
Total number of new enrolled students	531	4296.1	4078.375	52	24310
New enrolled students with no credits – males	525	422.1048	585.5896	0	7815
New enrolled students with no credits – females	518	398.3687	666.5353	0	8896
Architecture/Engineering students with no credits	365	129.9342	217.8574	0	2921
Economics/Statistics/Political sciences students with no credits	485	217.6124	314.9277	0	4219
Chemistry/Physics/Science students with no credits	335	68.30149	91.42803	0	998
Literature/Linguistics/Educational sciences students with no credits	428	182.6776	304.3474	0	2939
Medicine students with no credits	317	36.25552	75.616	0	641
Quotas no credits students					
Quota of new enrolled students with no credits	180	.171057	.1118465	.009901	1.007679
Quota Architecture/Engineering students with no credits	352	.1547728	.1204614	0	1.009678
Quota Economics/Statistics/Political sciences students with no credits	470	.1743455	.1334832	0	1.585366
Quota Chemistry/Physics/Science students with no credits	312	.2033204	.1269825	0	1
Quota Literature/Linguistics/Educational sciences students with no credits	415	.1637015	.1194484	0	1.010518
Quota Medicine students with no credits	273	.070232	.0957631	0	1
New enrolled students' high school					
Architecture/Engineering students from professional/technical high schools	352	397.0795	460.1097	0	2720
Architecture/Engineering students from lyceum	352	452.733	640.0079	0	3773
Architecture/Engineering students from other high schools	352	19.6875	41.85328	0	410
Chemistry/Physics/Science students from professional/technical high schools	312	158.266	145.6744	0	708
Chemistry/Physics/Science students from lyceum	312	171.9583	164.0911	0	887
Chemistry/Physics/Science students from other high schools	312	5.839744	7.673814	0	47
Literature/Foreign lang./Education students from profess./technical high schools	541	256.5545	361.9445	0	2518
Literature/Foreign lang./Education students from lyceum	541	416.8152	577.4969	0	2935
Literature/Foreign lang./Education students from other high schools	541	16.49538	27.42496	0	147
Economics/Statistics/Political sciences students from professional/technical high schools	540	509.4741	546.9649	0	3793
Economics/Statistics/Political sciences students from lyceum	540	466.1852	526.8998	0	3254
Economics/Statistics/Political sciences students from other high schools	540	27.70926	44.47628	0	270
Medicine students from professional/technical high schools	273	286.2198	294.0201	2	2492
Medicine students from lyceum	273	245.7949	200.3628	5	1232
Medicine students from other high schools	273	15.50916	18.2338	0	137
New enrolled students' diploma grade					
Architecture/Engineering students with diploma grade 90-100	366	299.5109	394.8664	0	2328
Economics/Statistics/Political sciences students with diploma grade 90-100	482	283.1452	269.4419	0	1543
Chemistry/Physics/Science students with diploma grade 90-100	335	89.61791	83.30172	0	335
Literature/Foreign lang./Education students with diploma grade 90-100	428	229.243	245.6484	0	1219
Medicine students with diploma grade 90-100 males	273	16.89744	18.84448	0	137
Medicine students with diploma grade 90-100 females	273	71.13553	48.04517	0	245

The fixed effects model has been estimated by considering as dependent variable the quota of new enrolled students who did not obtain credits over the total number of students enrolled at the first year. Students' inertia might signal their dissatisfaction towards university (the athenaeum or school chosen did not fit their expectations) as well as a change in their personal motivations.

Regressors relate to university characteristics such has number of decentralized branches, decentralized branches location (inside/outside the province where the teaching core organization is located), type of courses offered over the total courses (3 years degree vs. university diplomas), and to students' background (high school attended and final grade).

Results can be seen in Table 3.

Table 3 – Fixed effects model

Variable	Coefficient	Standard error
3 years degree courses	-0.066	0.143
Courses at decentralized branches	-0.0008	0.001
Number of decentralized branches	0.029***	0.010
Branches in the same province	-0.068*	0.117
Branches outside the province	-0.10	0.092
Average course at decentralized branches	-0.007	0.008
Quota students grade 90-100	-1.13***	0.353
Quota students from professional/technical schools	0.466***	0.094
Quota students from lyceum	0.282**	0.146
Quota students from other schools	-0.534	0.869
Constant	0.207	0.175
*** significant at 99%; ** significant at 95%; *significant at 90%		
R^2: within = 0.3254; F- Test = 4.92 Prob > F = 0.000		
$\sigma^2 u = 0.147$; $\sigma^2 e = 0.082$; $\rho = 0.762$ F-Test all $u_i = 0$: 4.86		

Overall, the F-test shows the significativity of the regression, but the value of R^2 is only around 0,32; therefore other variables should be included in the analysis.

Quota of 3 years degree courses over other courses (university diplomas, special schools, etc.) shows a negative but not significant coefficient (that would imply the higher the number of 3 years degree courses over other courses, the less the number of new enrolled students who do not obtain credits). Similar considerations arise when considering quota of 3 years degree courses over the number of courses taught in decentralized branches, as well as the mean of courses offered by decentralized branches: the estimated coefficients are negative but not significant.

A positive coefficient is associated with the number of decentralized branches: therefore, university dispersion over the territory acts as an obstacle to the regular prosecution of the studies.[5]

In spite of the legislator's likely intention to enlarge supply by allowing universities to set out decentralized branches, so to introduce incentives to enroll for students who do not live close to the main university sites, what happened is merely a re-localization of students, while the number of

[5] However, the number of decentralized branches is extremely changeable from one university to the other (for instance, the University of Aosta, a small atheneum, has no decentralized branches; on the other hand, the "Università Cattolica del Sacro Cuore" has 27 decentralized branches): in another estimation a correction factor for standard errors has been included, but the coefficient related to decentralized branches becomes not significant.

students per university has not changed significantly.[6] It might be interesting, however, to consider a similar estimation for students enrolled to second, or third year, as well as students who moved to decentralized branches from main university sites.

The effect due to the location of decentralized branches (within/ outside the same province) is not clear: both coefficients are inversely correlated with the acquisition of credits, but are not significant. Other supply variables related to teaching staff (quota of professors) and postgraduate programs (PhD courses with scholarships) have not been included in this estimation because not significant.[7]

Information about students' background, as seen in other studies, should verify the positive correlation between a good performance at school and university results. While lyceum is usually expected to provide a strong background for further academic studies, professional and technical institutes usually have work and practical skill orientations. A positive correlation between university dropouts and quota of students coming from professional institutes instead of lyceum, should confirm this hypothesis. Similarly, the diploma grade should corroborate the intuition that students who did well at high school are likely to succeed at university. While this second hypothesis is confirmed by results, so that students who obtained their diploma grading between 90 and 100 (best result) achieved credits during their first year at university, we note that quotas of students who attended professional or technical institutes as well as lyceum are positively correlated with inactivity at university (although the estimated coefficient is higher for professional institutes): such a result might be a signal of a general worsening in the education level reached by students when they enroll to the university, independently of the type of high school attended in the past.

Overall, it would seem that variables related to demand (students' background) are more relevant than those related to supply (university degree courses) in explaining credit acquisition for new enrolled university students.

Wald test carried out for groups of variables is particularly significant just for demand related variables.

The estimation has been repeated by applying random effects.

[6] As an example, the "Università Cattolica del Sacro Cuore" in Milan, in the academic year 2001-02 (one year before the reform) had 13 decentralized branches and 7262 new enrolled students; in the academic year 2007-08 the number of decentralized branches doubled, but the number of new enrolled students (8385) increased less than proportionally.

[7] However, when including the variable "PhD courses with scholarships", the variable related to the location of decentralized branches outside the province becomes significant: probably this could be interpreted as the signal that behind PhD programs there is a more articulated organization, i.e., a higher quality.

Table 4 – Random effects model

Variable	Coefficient	Standard error
3 years degree courses	-0.045	0.121
Courses at decentralized branches	-0.0005	0.001
Number of decentralized branches	0.002	0.004
Branches in the same province	-0.008	0.032
Branches outside the province	0.025	0.071
Average course at decentralized branches	-0.008*	0.004
Quota students grade 90-100	-0.590**	0.277
Quota students from professional/technical schools	0.298***	0.080
Quota students from lyceum	0.424***	0.134
Quota students from other schools	-0.572	0.593
Constant	0.062	0.156
*** significant at 99%; ** significant at 95%; *significant at 90%		
R^2: within = 0.2542; Wald χ^2 = 35.88 Prob > F = 0.001		
σ^2 u = 0.067; σ^2 e = 0.082; ρ = 0.402 Breusch-Pagan test Var (u) = 0 χ^2 = 19.45 Prob > χ^2 = 0.000		

Once again, variables related to demand are significant, rather than supply variables. However, the Breusch-Pagan test, carried out to check the regression assumption, shows how there is correlation between regressors and error term.

The fixed effects model has to be preferred, but it has some limits and appears not to be significant for variables related to supply.

A further specification of the analysis has been related to groups of schools. The objective has been that of checking if factors related to demand and supply have a different impact on the probability of dropout when groups of Schools are considered separately.

The main dataset has been split into 5 subsets, each one including, as observation units, only those universities where some faculties are presents: 1) Architecture/Engineering, 2) Economics/Statistics/Political Sciences, 3) Chemistry/Physics/Sciences, 4) Literature/Foreign languages/Education, 5) Medicine.

As in the former analysis with fixed effects model, SchoolsSchools of Law have been excluded: in fact, the degree course, originally settled as a four year course has been changed by a first reform into a three year course, and then again into a four year course (implementation of “laurea magistrale”). Such modifications occurred heterogeneously in universities with schools of Law.

Table 4 distinguishes universities by looking at schools and, hence, identifies those units included in the new 5 subsets.

Table 5 – Groups of schools and universities

	Architecture/Engineering	Economics/Statistics /Political Sciences	Chemistry/Physics /Sciences	Literature/Foreign Languages/Education	Medicine
1		Aosta		Aosta	
2		Bari	Bari	Bari	Bari
3	Bari Politecnico				
4	Basilicata	Basilicata	Basilicata	Basilicata	
5	Bergamo	Bergamo		Bergamo	
6	Bologna	Bologna	Bologna	Bologna	Bologna
7	Bolzano	Bolzano	Bolzano	Bolzano	
8					
9	Brescia	Brescia			Brescia
10	Cagliari	Cagliari	Cagliari	Cagliari	Cagliari
11	Calabria	Calabria	Calabria	Calabria	
12	Camerino	Camerino	Camerino	Camerino	
13		Casamassima - Jean Monnet			
14	Cassino	Cassino		Cassino	
15	Castellanza LIUC	Castellanza LIUC			
16	Catania	Catania	Catania	Catania	Catania
17	Catanzaro	Catanzaro	Catanzaro		Catanzaro
18	Chieti	Chieti	Chieti	Chieti	Chieti
19	Enna Kore	Enna Kore	Enna Kore	Enna Kore	
20	Ferrara	Ferrara	Ferrara	Ferrara	Ferrara
21	Firenze	Firenze	Firenze	Firenze	Firenze
22		Foggia		Foggia	Foggia
23	Genova	Genova	Genova	Genova	Genova
24	Insubria	Insubria	Insubria	Insubria	Insubria
25	L'Aquila	L'Aquila	L'Aquila	L'Aquila	L'Aquila
26	Lecce	Lecce	Lecce	Lecce	
27		Macerata		Macerata	
28	Marche	Marche			
29	Messina	Messina	Messina	Messina	Messina
30		Milano Statale	Milano Statale	Milano Statale	Milano Statale
31		Milano Bicocca	Milano Bicocca	Milano Bicocca	Milano Bicocca
32		Milano Bocconi			
33		Milano Cattolica	Milano Cattolica	Milano Cattolica	Milano Cattolica
34		Milano IULM		Milano IULM	
35	Milano Politecnico				
36		Milano San Raffaele		Milano San Raffaele	Milano San Raffaele
37	Modena e Reggio Emilia	Modena e Reggio Emilia	Modena e Reggio Emilia	Modena e Reggio Emilia	Modena e Reggio Emilia
38	Molise	Molise	Molise	Molise	Molise
39		Napoli Benincasa		Napoli Benincasa	Napoli Benincasa
40	Napoli Federico II	Napoli Federico II	Napoli Federico II	Napoli Federico II	Napoli Federico II
41	Napoli II	Napoli II	Napoli II	Napoli II	Napoli II
42		Napoli Orientale		Napoli Orientale	
43	Napoli Parthenope	Napoli Parthenope	Napoli Parthenope		
44	Padova	Padova	Padova	Padova	Padova

45	Palermo	Palermo	Palermo	Palermo	Palermo
46	Parma	Parma	Parma	Parma	Parma
47	Pavia	Pavia	Pavia	Pavia	Pavia
48	Perugia	Perugia	Perugia	Perugia	Perugia
49		Perugia Stranieri		Perugia Stranieri	
50		Piemonte Orientale	Piemonte Orientale	Piemonte Orientale	Piemonte Orientale
51	Pisa	Pisa	Pisa	Pisa	Pisa
52	Reggio Calabria	Reggio Calabria			
53	Roma Biomedico				Roma Biomedico
54					
55	Roma La Sapienza	Roma La Sapienza	Roma La Sapienza	Roma La Sapienza	Roma La Sapienza
56	Roma LUISS	Roma LUISS			
57		Roma LUMSA		Roma LUMSA	
58		Roma San Pio V		Roma San Pio V	
59	Roma Tor Vergata	Roma Tor Vergata	Roma Tor Vergata	Roma Tor Vergata	Roma Tor Vergata
60	Roma Tre	Roma Tre	Roma Tre	Roma Tre	
61	Salerno	Salerno	Salerno	Salerno	
62	Sannio Benevento	Sannio Benevento			
63	Sassari	Sassari	Sassari	Sassari	Sassari
64	Siena	Siena	Siena	Siena	Siena
65				Siena stranieri	
66		Teramo		Teramo	
67		Torino	Torino	Torino	Torino
68	Torino politecnico		Torino politecnico		
69	Trento	Trento	Trento	Trento	
70	Trieste	Trieste	Trieste	Trieste	Trieste
71	Tuscia	Tuscia		Tuscia	
72	Udine	Udine	Udine	Udine	Udine
73	Urbino	Urbino	Urbino	Urbino	
74	Venezia architettura			Venezia architettura	
75		Venezia Ca' Foscari	Venezia Ca' Foscari	Venezia Ca' Foscari	
76		Verona	Verona	Verona	Verona

Here, another estimation strategy has been applied.

The 5 subsets include several observations for each unit (longitudinal data). Our objective, as we have already stressed, is that of describing an outcome y_{ij} for subject i at time j, as a function of covariates x_{ij}. GLM models are frequently applied when longitudinal data are available, but their parameters vary across time as a stochastic process and/or across units because of heterogeneity.

There are two distinct approaches that could be selected in case of heterogeneity: a subject specific approach (an example is given by the mixed model, Laird and Ware 1982; Ware 1985) and a population average approach (Liang and Zeger 1986; Zeger *et al.* 1988; Stram *et al*. 1988). The latter does not explicitly accounts for subject to subject heterogeneity, hence the response for a given covariate value x_{ij} is directly estimable without further assumptions on the origin of dependency.

Population average models are effectively used in population studies: the Generalized Estimating Equations (GEE) can be formalized as follows:

$$U(\beta) = \sum_{i=1}^{N} \frac{\partial \mu_{ij}}{\partial \beta_k} V_i^{-1} \{Y_i - \mu_i(\beta)\}$$

where μ_i is the mean and V_i the variance.

The mean is given by:

$$g(E[Y_{ij} \mid x_{ij}]) = x_{ij}' \beta$$

where x_{ij} is a p times 1 vector of covariates, β consists of the p regression parameters of interest, g(·) is the link function, and denotes the *j* th outcome (for j = 1, … , J) for the *i*th subject (for i = 1, ..., N). β describes how the population average response depends on the covariates rather than one unit's response.

The variance is given by:

$$Var(Y_{ij}) = h^*(\mu_{ij}) \Phi$$

Examples of variance structure specifications include independent, exchangeable, autoregressive, etc.: the choice of such structure is based on empirical estimate of the correlation itself. Only the link function needs to be correctly specified to make consistent inferences about the estimated coefficients.

In the following estimations the dependent variable is dychotomic and assumes value = 1 if the percentage of new enrolled students who did not obtain credits for each group of schools is higher than 17,1%, (that is the average of students who did not obtain credits in the main dataset - students in all schools for all universities) and = 0 otherwise.

The link function is assumed to be probit or logit, there is independence in the correlation. Standard errors are robust and data distribution is binomial.

Results for each group of schools and marginal effects can be seen in the following tables:

Table 6 – GEE model for groups of schools

	Groups of schools				
Variable	**Architecture/ Engineering (link: probit, independent)**	**Economics/Statistics/Political Sciences (link: probit, independent)**	**Chemistry/Physics /Sciences (link: probit, independent)**	**Literature/Foreign languages/Education (link: probit, independent)**	**Medicine (link: logit, independent**
3 year degree courses	0.904 (1.107)	0.183 (0.840)	-0.837(1.169)	-2.545 (1.113)**	-7.097 (4.086)*
Courses at decentralized branches	0.013 (0.014)	0.056 (0.016)***	0.060 (0.020)***	0.043 (0.017)**	0.073 (0.027)***
Number of decentralized branches	-0.026 (0.056)	0.011(0.017)	0.045 (0.024)*	0.00007 (0.027)	0.174 (0.049)***
Sites in the same province	-0.090 (0.321)	0.268 (0.180)	0.102 (0.283)	0.214 (0.250)	5.047 (1.604)***
Sites outside the province	0.182 (0.398)	0.275 (0.214)	0.406 (0.472)	1.311 (0.427)***	-0.532 (0.768)
Quota students grade 90-100	-0.759 (1.533)	0.166 (1.423)	-4.883 (1.633)***	-2.738 (2.260)	-5.825 (5.612)
Quota students from professional/technical schools	-0.926 (1.250)	4.467 (2.024)**	7.118 (4.005)*	0.517 (0.999)	-3.033 (3.269)
Quota students from lyceum	-0.090 (1.611)	2.973 (2.113)	6.761 (4.064)*	-0.301 (0.784)	-2.442 (3.661)
Quota students from other schools	-18.819 (6.405) ***	-	-	-12.20 (5.229)**	-
Constant	-	-4.760 (2.141)**	-5.502 (3.812)	1.287 (1.144)	
Wald χ^2	15.79**	25.64**	34.59***	39.35***	75.66***
Standard errors in brackets *** significant at 99%; ** significant at 95%; *significant at 90%					

The same estimation strategy has been applied to all groups of Schools. It can be observed how, except for the group of scientific schools (Chemistry, Physics, Sciences), variables related to students' background are not significant.

Furthermore, variables related to universities need to be considered: the quota of courses taught at decentralized branches is significant for all group of schools but Architecture/Engineering, and is positively correlated with the probability to have a quota of new enrolled students not achieving credits higher than average. The number of decentralized branches is positively correlated with the dependent variable as well; this result would confirm, overall, the findings of the first part of the analysis: if the number of decentralized branches increases as well as taught courses, there is a higher probability for students to be inactive.

Variables related to students' background are significant only for the group of scientific schools; quota of students who studied at other schools than professional/technical high schools or lyceum (including foreign high schools) is significant and is not dropped only for Architecture/Engineering and, as expected, Literature/Foreign languages/Education. In the estimation for the humanities schools, another significant variable is the one related to decentralized branches outside the province: the correlation is positive and might signal the circumstance that, given the presence of foreign students in this group, once they have chosen to attend an Italian university, they (prefer not to) locate in decentralized branches outside the province. Anyway, these conclusions try to shed light on students' personal motivations instead of analyzing characteristics of supply.

Overall, the impression is that, in spite of the robustness of the estimation strategy selected, further explanatory variables might be added to clarify the impact exerted by supply and demand factors on first year students' inactivity.

Table 7 – GEE model: marginal effects

	Groups of schools				
Variable	**Architecture/ Engineering (link: probit, independent)**	**Economics/Statistics/Political Sciences (link: probit, independent)**	**Chemistry/Physics /Sciences (link: probit, independent)**	**Literature/Foreign languages/Education (link: probit, independent)**	**Medicine (link: logit, independent)**
3 years degree courses	0.312	0.072	-0.325	-0.992**	-0.103
Courses at decentralized branches	0.004	0.022***	0.023***	0.016**	0.001**
Number of decentralized branches	-0.009	0.044	0.017**	0.00003	0.002**
Sites in the same province	-0.031	0.104	0.040	0.082	0.044**
Sites outside the province	0.060	0.107	0.160	0.411***	-0.009
Quota students grade 90-100	-0.262	0.066	-1.901***	-1.067	-0.084
Quota students from professional/technical schools	-0.319	1.769**	2.771*	0.201	-0.044
Quota students from lyceum	-0.031	1.177	2.632*	-0.117	-0.035
Quota students from other schools	-6.50***	-	-	-4.755**	-
$Y = xb$	0.295	0.451	0.587	0.414	0.014
Standard errors in brackets *** significant at 99%; ** significant at 95%; *significant at 90%					

6.- Conclusions

Our research aimed at examining how factors related to supply might have an impact in determining university dropouts. From the first part of the analysis, carried out by applying a fixed effects model, it has been inferred that students' background has a high impact on students' inactivity (in line with main findings in existing literature). With regard to variables employed, those related to teaching staff were not significant: further analysis should concern teaching quality (but indicators of quality should be identified in advance) as well as the role of temporary teaching staff (working on a short term contract basis).

University economic resources should be taken into account as well as levels of employment and other macroeconomic variables: information about how much universities cost on average (by looking also at contributions paid by students to their universities) and other opportunities students might have, instead of enrolling at academic courses, might explain the willingness to drop university courses.

Our results obtained in the first part of the analysis suggest that a crucial role can be associated with decentralized branches: dropouts seem to be influenced by a high number of branches and university fragmentation across territories. Therefore, a more solid organization focused around a core unit might perhaps offer a more attractive academic environment for students and help to reduce dropouts.

The second part of our analysis has considered distinct groups of schools: for some of them (for instance, architecture/engineering) variables related to supply side are not significant. This evidence requires further analysis to specify types of courses and employment opportunities and results have to be considered jointly with those obtained in the first part. If, overall, demand side factors (students' characteristics such as background) are relevant in explaining dropouts at a general level, when we turn to considering single areas of study, organizational aspects of courses and universities become significant, especially with regard to some schools (such as medicine and scientific schools). This circumstance would confirm our original intuition: dropouts depend both on demand and supply factors.

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