Does a reform on regulation of teaching activity impact on academic outcomes? Evidence from Italy*

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Abstract

In the present paper, using administrative data from a public university located in the North of Italy, we investigate the impact of a recent but little known higher education reform, which induces significant changes in the teaching activities of universities, on the dropout and graduation rates of college students. Our findings indicate that freshmen's dropout rate significantly increased, while the graduation rates decreased after the reform has taken place.

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1 Introduction

Human capital accumulation has been increasingly central in debates and policy decisions related to national economic performance. Although there is overwhelming evidence that people who invest in education, especially tertiary education, have better job opportunities, lower risk of being unemployed, and earn more over their entire working lives (see e.g. Ashenfelter and Ham 1979; Becker and Chiswick 1966; Bratti 2001; Card 1999; Lochner 2004; Meara et al. 2008), in Italy only a tiny fraction of the population achieves the highest level of education. According to the OECD (2016), despite an increase in educational achievement–mainly for recent cohorts–Italy remains in the bottom part of the education distribution for the OECD countries and shows a persistent gap with other developed countries. For instance, in 2015, the fraction of Italy's population aged 25-64 with tertiary education was 18%, while the average in the OECD countries was around 35%; for the youngest cohort (aged 25-34), the figures were 25 and 42%, respectively. The small number of graduates is strongly related to persistent high dropout rates from the Italian university system despite efforts by the Italian Ministry of Education over the years, to increase retention.

Since the beginning of the 2000s, the Italian university system experienced remarkable changes. One of the little known reform, the so called "Riforma Mussi (from the name of the former Ministry of Education) approved in 2007, introduced a stricter regulation of the teaching activity in response to the excessive proliferation of degree programs and to the fragmentation of the study plans recorded since the introduction of the 3+2 system in 2001. According to the guidelines published by the Italian Ministry of Education,

University and Research (Miur)[1], the aim of the reform was to improve the effectiveness, the quality and the coherence of the degree programs so as to increase the number of graduates, to reduce the dropouts and the time-to-degree, recognized as the main issues of the Italian tertiary education system.

This paper uses administrative data of the Università del Piemonte Orientale (hereafter UPO) to investigate if the reshuffle of the teaching activity succeeded in reducing withdrawal. In particular, we estimate the effect of the reform on the probability of dropping out within the first year of enrollment, as at this stage university system registers the highest proportion of failure (i.e. about 20%). This reform introduced several constraints to the study programs of each degree course, among them a maximum number of exams to be passed to get the degree (20 for the 3-year degree courses, 12 for the 2-year master degree courses), and a minimum number of permanent faculty members (so called requisiti minimi).

On the one hand, exploiting these changes jointly with the timing of their introduction, we analyze if a stricter regulation of the teaching activity has fostered students stay at university (as claimed by the guidelines of the reform) or, on the other hand, if the burdensome workload of each exam worsens the propensity to dropout earlier. We exploit the possibility to comply with the new rules in two different academic years (2008/2009 and 2009/2010) to apply a difference-in-difference empirical strategy to estimate the causal effect of the reform. Indeed, at UPO degree courses belonging to socio-economic and humanistic degree classes were reformed in the first academic year (2008/2009), while those belonging to the scientific degree classes in the second academic year (2009/2010).

[1] http://attiministeriali.miur.it/UserFiles/2599.pdf

Our estimate results show that after the introduction of Mussi's reform the dropout rate of first year students in the scientific degree programs significantly increased on average by 22 percentage point (the base dropout rate is 22%), while this effect is smaller but still significant on the dropout rate of degree programs in Social Sciences and Humanities with a 10 percentage points average increase (the base is 26%). Although the difference in the size of the effects across scientific areas can be explained by the increased enrollment numbers of degree programs in Science, we show that still this cannot explain the entire worsening situation in the outcomes by itself. Furthermore, our results indicate that graduation rates significantly decreased by 13 percentage points (the base is 50%) in the degrees in Science. These significant negative effects on the students of scientific degrees are worrisome given the importance of STEM[2] graduates in the labour markets and countries' growth.

The paper is organized as follows. Existing studies section reviews the literature. The institutional framework describes the Italian university system and the details of Mussi's reform. Section-4 describes the data and descriptive statistics. In Section-5 we discuss the identification strategy and the econometric approach. The sixth section presents the results and the last section concludes.

2 Existing Studies

Regarding the probability of withdrawing from university, the most important theoretical models are those proposed by Tinto (1975), Bean (1980) and Bean and Metzner (1985), which identify attrition especially as the result of failed

[2]science, technology, engineering and mathematics.

interaction between student and university. These types of models stress the influence of students previous schooling, academic preparedness, personal characteristics, family background and institutional characteristics.

A number of empirical studies have examined the extent of university enrollment and persistence in the tertiary education system, using factors that influence students behavior, for instance, personal traits, student entry characteristics, parental background, financial resources, academic performance and labour market conditions, but few studies look at the structure of the degree programs.

A review of the literature on intergenerational transmission of education shows that parents education is extremely relevant in childrens attainment, although it varies by country and national education system (Haveman and Wolfe 1995). In one of the first comparative studies of intergenerational persistence in education, Blossfeld and Shavit (1993) analyze the relationship between parental background and childrens attainment and find that intergenerational mobility was not improved by the observed expansion in tertiary education in 11 of the 13 countries analyzed. Based on the substantial expansion in education in the United Kingdom, Galindo-Rueda and Vignoles (2005) find strong evidence for a weaker correlation between ability and educational attainment with an increased impact of parental background. Also for Germany, Heineck and Riphahn (2009) confirm that inequality in educational attainment did not decline in the last half of the twentieth century. Recent research on the association between parental background and childrens attainment in Italy, though based on different data sources, shows similar results, that is, that cultural family background is a key factor in explaining university attendance. Triventi and Trivellato (2009), using

data from five waves of the Italian Longitudinal Household Survey, analyzed the performance of Italian undergraduates in the twentieth century. They show that enrolment and success at university are strongly related to family background, and that the worst results are consistently associated with a lower-middle class background. The persistence of education inequalities is noted also in Checchi et al. (2008). Checchi and Flabbi (2006) confirm the important role of parents in shaping high school trackat least one parent with a university degree increases the probability of selecting into the academic track (i.e. licei) and has an impact on childrens post-secondary education. While the expansion in higher education in Italy has been analyzed, the results suggest that reducing inequality increases access for children from poorer backgrounds, but does not increase chances of completion (Bratti et al. 2008; Cappellari and Lucifora 2008). College attendance is also positively affected by family financial resources. The theoretical literature shows that wherever there are credit constraints, low-income families may not be able optimally to invest in the human capital of their offspring (Han and Mulligan 2001). The empirical evidence of substantial differences in university enrollment rates across family income classes suggests that income inequalities across generations and ethnic groups may be widening (see Blossfeld and Shavit 1993; Blanden and Machin 2004; Galindo-Rueda and Vignoles 2005). Labour market prospects also play a role in university enrolment, and we would expect a positive correlation between unemployment rate and college participation rates (see Checchi 2000; Cappellari and Lucifora 2008). For the role of parental background (proxied by parents education or occupation), most studies conclude that there is significant positive correlation in economic explanations of dropout behaviour (see Johnes and McNabb 2004; Ahlburg et al. 2002; Checchi 2000; Di Pietro 2004; Cappellari and Lucifora 2008; Triventi and Trivellato 2009). A generous

funding system of university can (e.g. scholarships, loans) positively affect completion (Herzog 2006).

Finally, other dimensions influence the likelihood of withdrawal such as rules and degree program structures. For instance, tertiary education systems applying stricter criteria to their admission process are characterized by lower dropout rates compared to less selective universities (Bowen et al., 2009; Bound et al., 2010). Also the organization of teaching activities – especially those regarding rules to access exams, possibility to resit exams, number of sessions available for thesis examination, etc.–, might affect students performance as well. Even though there is no robust empirical evidence corroborating such hypothesis, it is possible that an excessive freedom given to students to organize their studies does not necessarily favor the attainment of the degree (see Löfgren and Ohlsson 1999).

We contribute to the existing literature evidence of the role played by a change in the regulation of teaching activities on the dropout behaviors of Italian university students.

3 Institutional Background: Mussi's Reform

The changes introduced by Mussis reform can be considered "marginal as the organization of the Italian university system, regulated by the 1999 and 2004 laws (i.e. the 3+2 system, the number of ECTS[3] required to get the degrees, the organization of the degree courses according to the main field–classi di laurea[4]), remains unaltered. However, the Ministry Decree 155/2007

[3]European Credit Transfer System.

[4]3-year degree programs (Corso di Laurea) are organized in 43 degree classes (classi di laurea); 2-year degree programmes (Laurea Magistrale) in 94.

introduced several not negligible changes to the organization of the university teaching activity. In particular, the reform affects quite few aspects of the university teaching activity, namely the design of the degree programs.

The first intervention refers to the introduction of a minimum number of ECTS (90 over 180 in the bachelor 3-year degree and 60 over 120 in the master 2-year degree) to be taught by permanent faculty staff (full professors, associate professors and assistant professors). Such limit aimed at reducing the number of degree programs, which has been unevenly growing in the years following the 2001 reform, often supported by temporary (and not always qualified) lecturers. For the same purpose, degree programs belonging to the same degree group have to differentiate for at least 40 ECTS (30 in the 2-year master degree).

The second intervention, that has probably the clearest and immediate impact on students outcomes, is the setting of a maximum number of exams required to get the degree, and the consequent re-organization of the study plans. Up to the 2007 reform, universities were allowed to freely determine the number of exams to achieve 180 ECTS for the 3-year degree (Corso di Laurea) and 120 ECTS for the 2-year degree (Laurea Magistrale). This freedom left to universities led to twofold heterogeneous situations. Firstly, an excessive fragmentation of certain degree programs, with a huge number of small and barely coordinated exams. Secondly, a great difficulty (impossibility) to move from a university to another, due to the differences in the organizations of the study plans. The introduction of this cap in the total number of exams aimed to force universities to ameliorate their degree supply, through the cooperation between professors of different classes and fields. Obviously, since the number of ECTS did not change, the unforeseen consequence of this reform has been

in an increase of the workload (in terms of ECTS) for each exam.

The mobility across universities is granted by a further element of the reform: universities that "receive" students from other universities must recognize at least 50% of the exams already passed in the university of "origin", provided that they move from a degree course of the same degree group (classe di laurea).

Since the reform introduced several changes to the organization of the degree courses, universities were allowed to comply with the new rules within two academic years (2008/2009 and 2009/2010). The only constraint was that all the degree programs belonging to the same degree group in the same university had to apply the reform in the same academic year[5].

4 Data and Descriptive Statistics

The data we use in this paper is provided by the administrative office of the Università del Piemonte Orientale (UPO). UPO is a public university based in Piomente region of Italy with three campuses in Alessandria, Novara and Vercelli provinces. University offers student a wide range of courses in 3-year bachelor degrees; 2-year master degrees and 5 or 6 year degrees which are equivalent to have 3 (bachelor)+2 (master) degrees. In a given academic year, an average number of students in UPO is approximately 11,000. During the academic years we work with, the teaching activities of the university are organized by 7 faculties. Namely, Science (mathematics, physics and natural sciences), Medicine, Pharmacy, Law, Political Science, Economics, Literature and Philosophy. These 7 faculties are aggregated into 4 scientific

[5]For instance, all the degree courses belonging to the degree class L35 (Mathematics) in the same university had to apply the new rules in the same academic year.

areas: Medicine and Pharmacy faculties into Medicine (*area sanitaria*); Science faculty into Science (*area scientifica*); Law, Economics, Political Science into Social Sciences (*area sociale*); Literature and Philosophy into Humanities (*area umanistica*). We can identify these four scientific areas in our data, which is crucial to do so considering the fact that the degree programs were obliged to make the necessary changes in their teaching activities simultaneously based on the scientific area that they belong rather than the faculty.

We restrict our sample to first year bachelor degree (3-year) students in order to have more homogeneous and comparable treatment and control groups since the students enroll in master degrees and in 5 (Pharmacy, Law) or 6 (Medical school) year degrees are more likely to be more skilled with different motives than the bachelor degree students.

In the end, our main working sample consists of approximately 16,000 first year bachelor degree students spanning the academic years from 2002/03 to 2010/11[6]. We have accurate information on the date students enroll in the relevant degree program and the date they exit with explanation of why they exit– i.e. as dropout or graduate. We also have some information on the observable characteristics of students, such as gender, age, high-school graduation mark, the type and area of high-school student graduated from, which are used as control variables in the regressions.

The timing of the introduction of reform to the degree programs varies across the scientific areas at UPO, which enables us to have an identification

[6]The raw data provided by the university actually cover the academic years from 2001/02 to 2015/16. However the academic year 2001/02 is the first of a 2001 higher education reform, "Bologna Process", hence the outcomes of interest are affected mostly by the 2001 reform and this would lead us to have biased estimates. As for the academic years after 2010/11, since the Medicine scientific area is the last to apply the changes in the teaching activities in 2011/12, we are not able to identify the parameters of interest in the subsequent year and thus we exclude the year after 2010/11 from our working sample.

strategy to estimate the parameters of interest. The degree programs in Social Sciences and Humanities introduce the reform in 2008/09, while the degree programs in Science introduce it in 2009/10. Finally, in the academic year of 2011/12, degree programs in Medicine make the changes according to the new regulation. The identification strategy shall be discussed in the Section-5.

4.1 Variables

Our main outcome of interest is the first year dropout rate while we also look at the changes in the graduation and graduation on time rates. In the data, the dropout is specified by two different label. First one is the official dropout (*rinuncia*) which is the case if student officially informs the administrative about her leave. In the second case of dropout (*decadenza*), student dropouts out without informing the administrative office but the in the following years the administrative office detects this student's leave and records her as a dropout. Nevertheless, it has been officially confirmed by the administrative officials at UPO that the information on dropouts in the academic years our working sample covers are up-to-date.

The definition of graduation variable is quite straightforward. If a student graduates from her degree course at any academic year in our data, she is considered as a graduate in the cohort year she is enrolled in. On the other hand, graduation on time variable is defined according to the legal duration of a bachelor degree, which is decided by the Minister of Education. For instance, consider a student enrolls into a degree program in October 2002, if she completes her degree until the May 2006. Basically, students are allowed to have 6 more months after completing their 3 years in the degree to be defined as graduates on time.

In Table 1, Table 2, Table 3, Table 4, we report the mean statistics of variables over the years by scientific areas of Medicine. Science, Social Sciences, Humanities, respectively. The dropout (graduation) rate in Medicine is low (high) and stable over the years with respect to other scientific fields at UPO. Science, on the other hand, has fairly high but stable dropout rate until 2009 and then it increases from 23% in 2008 to 35% in 2009 and to 48% in 2010. Social Sciences and Humanities, have pretty similar dropout and graduation rates over the years. In descriptive context we observe an increase in the dropout rate of Social Sciences (from 29% to 35%) in 2008, which the year reform was introduced to Social Sciences and Humanities, while the dropout rate of Humanities seem not to be affected.

5 Identification and Empirical Framework

We estimate a linear probability model to capture the effects of the reform on the outcomes of interest (dropout, graduation and graduation on time rates) by employing a simple difference-difference approach. In order to identify our parameters of interest, we exploit the fact that different scientific areas in the university have applied the necessary changes required by the reform at different years.

As mentioned beforehand, the scientific areas of Social Sciences and Humanities have made the changes in 2008/09; scientific area of Science in 2009/10 and the scientific area of Medicine in 2011/12. Therefore, we split our data into two estimation samples. The first estimation sample consists of only Science and Medicine scientific areas, where we treat the degree programs in Science as the treated group while the degree programs in Medicine as

the control group. Accordingly, we estimate the effects of the reform on the performances of Science students for the academic years 2009/10 and 2010/11. The second sample, on the other hand, contains all the four scientific areas in the university. This time scientific areas of Social Sciences and Humanities are the treated group and the Medicine and Science are control. We estimate the effects of the reform for the students in Social Sciences and Humanities for the academic year 2008/09[7].

The econometric specification we use to estimate the effects of reform is as follows:

$$Y_i = a + \gamma SA_i + \lambda POST_t + \delta(SA_i \times POST_t) + X_i\beta + \epsilon_i; \tag{1}$$

where Y_i is a binary outcome of interest, SA_i is a dummy which is equal to 1 if i is a student of treated scientific area, $POST$ is a dummy and is equal to 1 if the academic year t is a post reform year, X_i is the observable characteristics of student i, the parameter of interest we want to estimate is δ which provides us the average treatment effects. We replicate Equation 1 for each academic outcome we are interested in this paper.

We cluster the standard errors at the degree program and academic year level. In the end, we have 180 clusters in the sample we estimate the effects on the students of social sciences and humanity scientific areas and 100 clusters in the sample we use to estimate the effects on the students of science area.

[7]The reason we only estimate the effects for one academic year is because scientific area of Science apply the reform in 2009/10 so we lose the identification for the subsequent academic years. One might suggest to use only Medicine as a control group and estimate the effects on the Social Sciences for multiple year, however, when the latter is the case the critical common trend assumption of difference-in-difference approach does not hold.

5.1 Event-study Specification

In addition to our baseline model, Equation 1, we also set up an event-study specification to check whether the common trends assumption of difference-in-difference approach is satisfied in our estimation samples. More specifically, given the first academic year as a baseline, we estimate coefficient estimates of interaction terms (treated group x time dummies) for each year instead of estimating those coefficients only for the actually treatment years. If the common trend assumption holds, we should not observe any significant coefficient estimates regarding the interaction terms associated with the academic years prior to the reform.

We set up the following model as an event-study specification:

$$Y_i = \alpha + \gamma SA_i + \sum_{k=2003}^{T} \lambda_k P_k + \sum_{k=2003}^{T} \delta_k (SA_i \times P_k) + X_i\beta + \epsilon_i, \qquad (2)$$

where $k = 2003, 2004, ..T$[8], P_k are the dummy variables which is equal to 1 in year k, SA_i is equal to 1 if student i is in the treated scientific area, X_i is the observable characteristics of student i, the coefficient estimates of interaction terms, δ_k, are the parameters of interest in the model. As is in our main specification, we cluster the standard errors at degree program and academic years.

6 Results

Table 5 reports the results obtained from Equation 1 for our first estimation sample, where the bachelor degrees of Science are the treated group and the

[8] T is equal to 2010 and 2008 for the first and second estimation sample, respectively.

bachelor degrees of Medical School are the control group. In the columns (1) and (2), Table 5 Panel-A, we show the effects of the reform on the first year dropout rates without and with including control variables into the model, respectively. We observe a huge and significant increase in the first year dropout rates after the reform on average by 22 percentage points. Given the base dropout rate of bachelor degrees in Science for the years prior to reform is 22%, the latter finding is equivalent to a raw 100% increase. As for the effects on the graduation rate, columns (3) and (4), we see an average reduction of 13 percentage points after the reform (the base graduation rate of treated group is 50%). On the other hand, the effects on the graduation on time rate is weaker and smaller in size with respect to the effects on graduation rates. When the control variables on the observables are not taken into account, column (5), we observe on average 11% decrease in the graduation on time rate, while once the controls are included into the estimation process, column (6), the effect becomes a reduction of 7 percentage point but not statistically significant.

In Figure 1, Figure 2 and Figure 3 we plot the estimation results of even-study specification obtained from Equation 2 on the first years dropout, graduation and graduation on time rates, respectively. In those figures we see that the outcomes of treatment and control group over the pre-reform years follow a common trend while with the implementation of the changes required by the reform increases (decreases) the dropout (graduation, graduation on time) rates. Moreover, as can be seen in the figures that the effect is stronger in the second year of the reform, 2010/11, than the effect in the academic year 2009/10.

As a robustness check, we replicate the results for each academic outcomes while the Biotechnology degree course are excluded from our first estimation

sample. Biotechnology even though is a part of the Science scientific area and applied the changes at the same time with the other degrees in Science, in practice it is organized by the Pharmacy Department which is a part of Medical School. Therefore, the effects on the students in this degree might differ from the other degrees in our treatment group. The results without Biotechnology presented in Table 5 Panel-B. In the light of our initial expectations, we observe a 50% reduction in the effects on each outcome of interest. Nevertheless, we still see a significant increase in the first year dropout rate by 9 percentage points while a decrease in the graduation rate about 8 percentage points after the reform.

We present the results in Table 6 for the effects on the academic outcomes of students enroll into the degree courses in Social Sciences and Humanities. This time we have a much larger sample since our second estimation sample contains all the scientific areas in the university (Social Sciences and Humanities are the treated group in 2008/09 while Medical School and Science are the control group). We find a 10 percentage points increase in the first year dropout rates after the reform (base is 26%). As for the effects on the graduation, although the coefficient estimates are not statistically significant the standard errors are in reasonable magnitude (smaller than the point estimates). Moreover, the coefficient estimates for the graduation rate are negative. The effects on the graduation on time, on the other hand, is smaller and this time the standard errors are fairly large compared to the estimates on the total graduation rate.

In Figure 4, Figure 5, Figure 6 we plot the results of event-study specification on each outcome of interest obtained from the second estimation sample. Once again, we can verify that the common trend assumption over the pre-reform years.

Furthermore, the effects on the outcomes of Social Science and Humanity students are smaller with respect to the effects on the Science students estimated from full sample (Table 5; Panel-A). However, when we compare the estimated effects from a sample in which Biotechnology degree is excluded (Table 5; Panel-B) to the effects on the Social Sciences and Humanities, we see that they are very similar to each other.

On the other hand, one might argue that the substantial increase in the dropout rate in Science might have been driven by the increase in the enrollment numbers after the reform. The increased number of enrolled students might have had some role on the increase in dropouts but still it would not entirely explain the worsening situation. As can be seen in Table 2, the average number of students during the pre-reform years in Science is about 360, while this number becomes 442 during 2009/10 and 2010/11. The dropout rate regarding the years prior to the reform is 22% while it is 41,5% for post reform years. Therefore, during the pre-treatment years an average number of dropouts is 80 students, and after the reform it is 184 students. Consider a worst case scenario situation that all the additional students after reform (442-360=82) dropping out, which would make the number of dropouts 162 (80+82). In the latter case the dropout rate for the post reform years would be 36% (162/442=36) which is still 6% less than the actual dropout rate we observe for the post reform.

All the findings mentioned above indicate that the introduction of the reform seems to have worsened the academic performances of students, which contradicts with the initial purpose of this reform. We attribute the results to the increased amount of workload for each exam. Given the high level dropout rates in Italy and in the university under study in this paper, the

new regulation on the teaching activities might have discouraged students and increased the dropout rates.

7 Concluding Remarks

In this paper, we have examined the impact of a higher education reform regarding the teaching activities on the academic outcomes of students by using an administrative data of a public university located in the North of Italy. We have found that the introduction of the reform significantly increased the first year dropout rates and decreased the graduation rate, while the effect on the graduation on time rate is small and mostly not significant. We interpret this result as evidence of an increased workload per exam since the reform set a maximum number of exam for courses while keeping the total amount of credits should be achieved by the students same.

Overall, the results vary across the scientific areas and the effects on the outcomes of students enrolled into the degree programs in Science are larger with respect to the effects on Social Science and Humanity students. The latter finding is disquieting since STEM degrees provide high-skilled employees and are too important to labor markets. A future research could be investigating the differences in the labor market outcomes of pre- and post-reform graduates with a proper data.

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Appendix

Table 1: Descriptive statistics of first year students enrolled in bachelor degrees in Medicine over the academic years

Years	Enrollment	Female %	HS. Final Marks	HS. Types %						Dropouts %			Graduation %	
				Prof.	Tec.	Class.	Sci.	Ling.	Oth.	Rin.	Dec.	**TOT**	On time	**TOT**
2002	777	71	74	20	30	7	15	9	18	7	6	13	61	74
2003	567	71	74	22	29	5	15	10	17	10	6	17	48	68
2004	580	72	74	19	32	4	19	11	13	14	7	21	49	65
2005	530	71	74	14	35	7	18	8	16	10	6	16	53	68
2006	543	68	74	12	33	6	21	10	15	10	5	15	54	69
2007	653	66	73	11	36	5	21	11	13	9	5	15	46	64
2008	623	66	74	13	31	5	27	11	11	8	5	13	52	72
2009	603	64	74	8	33	7	30	9	13	7	5	12	51	69
2010	585	64	75	6	31	8	34	8	12	8	4	12	58	74

Table 2: Descriptive statistics of first year students enrolled in bachelor degrees in Science over the academic years

Years	Enrollment	Female %	HS. Final Marks	HS. Types %						Dropouts %			Graduation %	
				Prof.	Tec.	Class.	Sci.	Ling.	Oth.	Rin.	Dec.	**TOT**	On time	**TOT**
2002	469	39	77	9	46	4	23	5	11	10	8	19	26	49
2003	366	44	78	8	40	4	25	7	15	8	11	19	31	55
2004	366	41	80	6	49	3	20	6	14	12	12	24	25	49
2005	392	40	78	7	36	5	28	7	16	15	8	24	21	51
2006	330	44	79	6	38	5	24	8	18	15	8	23	21	51
2007	290	48	79	7	38	4	25	10	14	19	6	25	22	44
2008	311	43	77	6	36	8	27	8	14	17	6	23	20	49
2009	400	50	75	5	34	8	28	7	16	26	9	35	16	42
2010	484	57	74	6	31	7	29	10	15	38	10	48	14	32

Table 3: Descriptive statistics of first year students enrolled in bachelor degrees in Social Sciences over the academic years

Years	Enrollment	Female %	HS. Final Marks	HS. Types %						Dropouts %			Graduation %	
				Prof.	Tec.	Class.	Sci.	Ling.	Oth.	Rin.	Dec.	**TOT**	On time	**TOT**
2002	1227	57	77	9	40	5	19	10	16	9	13	22	25	49
2003	1169	56	77	9	37	7	18	10	18	9	16	25	23	46
2004	1127	55	77	9	41	6	15	10	18	14	15	29	18	37
2005	881	57	77	8	38	8	18	8	18	11	13	24	22	42
2006	791	53	77	8	43	6	15	12	15	14	15	29	19	41
2007	809	56	75	6	39	5	21	12	16	16	13	29	23	41
2008	847	54	75	7	47	7	18	10	10	18	17	35	18	40
2009	808	53	74	7	40	7	20	11	13	16	14	29	21	38
2010	788	55	74	8	39	6	20	10	16	13	12	27	27	42

Table 4: Descriptive statistics of first year students enrolled in bachelor degrees in Humanities over the academic years

Years	Enrollment	Female %	HS. Final Marks	HS. Types %						Dropouts %			Graduation %	
				Prof.	Tec.	Class.	Sci.	Ling.	Oth.	Rin.	Dec.	**TOT**	On time	**TOT**
2002	507	70	78	16	26	11	17	11	17	10	12	21	19	51
2003	510	71	77	14	28	10	19	10	18	12	13	25	24	50
2004	472	69	77	14	29	10	15	15	16	14	13	27	22	43
2005	432	67	78	11	30	6	16	16	19	15	11	26	18	46
2006	442	71	77	14	30	10	16	15	14	19	13	31	18	41
2007	481	71	76	9	28	12	18	13	19	19	12	31	16	39
2008	324	78	77	7	23	13	16	22	17	18	14	32	18	39
2009	279	75	74	5	20	15	20	21	17	20	5	25	21	42
2010	234	76	76	6	23	10	21	19	20	19	5	24	27	37

Table 5: **Effects of the reform on the academic outcomes of first year students in science**

Panel-A: Full sample

	(1) Dropout	(2) Dropout	(3) Graduate	(4) Graduate	(5) Grad.on time	(6) Grad.on time
$SA_i \times POST_t$	0.236***	0.221***	-0.164***	-0.133***	-0.116**	-0.073
	(0.061)	(0.064)	(0.044)	(0.041)	(0.057)	(0.052)
SA_i	0.068***	0.086***	-0.190***	-0.232***	-0.282***	-0.322***
	(0.016)	(0.016)	(0.025)	(0.024)	(0.032)	(0.033)
$POST_t$	-0.033	-0.018	0.029	0.022	0.024	0.004
	(0.013)	(0.011)	(0.029)	(0.040)	(0.046)	(0.040)
Controls on observables	NO	YES	NO	YES	NO	YES
N	8866	8397	8866	8397	8866	8397

Panel-B: Biotechnology excluded

	(1) Dropout	(2) Dropout	(3) Graduate	(4) Graduate	(5) Grad.on time	(6) Grad.on time
$SA_i \times POST_t$	0.115***	0.094***	-0.110**	-0.077*	-0.071	-0.028
	(0.030)	(0.030)	(0.047)	(0.041)	(0.057)	(0.050)
SA_i	0.080***	0.090***	-0.222***	-0.254***	-0.308***	-0.337***
	(0.016)	(0.017)	(0.023)	(0.023)	(0.031)	(0.033)
$POST_t$	-0.034	-0.020*	0.029	0.009	0.024	0.004
	(0.013)	(0.011)	(0.029)	(0.024)	(0.046)	(0.040)
Controls on observables	NO	YES	NO	YES	NO	YES
N	8098	7640	8098	7640	8098	7640

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, robust and clustered standard errors in parenthesis. The list of control variables used in the regressions: age, gender, high-school graduation mark, the type and area of high-schools students graduated from.

Table 6: **Effects of the reform on the academic outcomes of first year students in social sciences and humanities**

	(1) Dropout	(2) Dropout	(3) Graduate	(4) Graduate	(5) Grad.on time	(6) Grad.on time
$SA_i \times POST_t$	0.101***	0.093***	-0.067	-0.063	-0.032	-0.018
	(0.027)	(0.026)	(0.050)	(0.053)	(0.062)	(0.065)
SA_i	0.081***	0.077***	-0.176***	-0.170***	-0.206***	-0.204***
	(0.012)	(0.012)	(0.027)	(0.030)	(0.032)	(0.036)
$POST_t$	-0.021	-0.012	0.028	0.022	0.000	-0.010
	(0.020)	(0.022)	(0.041)	(0.048)	(0.060)	(0.063)
Controls on observables	NO	YES	NO	YES	NO	YES
N	16813	16100	16813	16100	16813	16100

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, robust and clustered standard errors in parenthesis. The list of control variables used in the regressions: age, gender, high-school graduation mark, the type and area of high-schools students graduated from.

Figure 1: **Event-study specification on dropout rate: Science vs. Medical School**

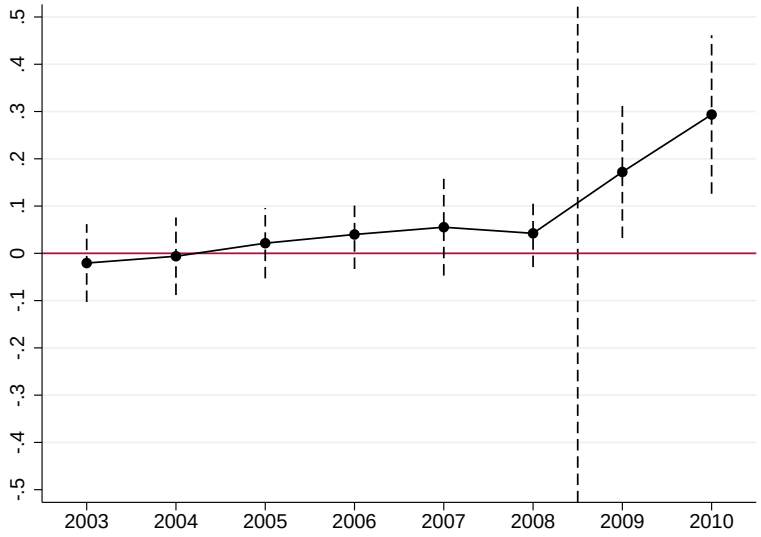

Figure 2: **Event-study specification on graduation rate: Science vs. Medical School**

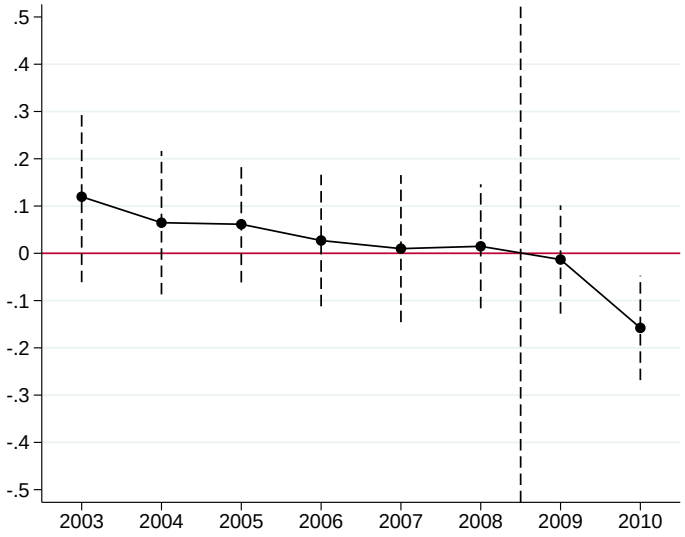

Figure 3: **Event-study specification on graduation on time rate: Science vs. Medical School**

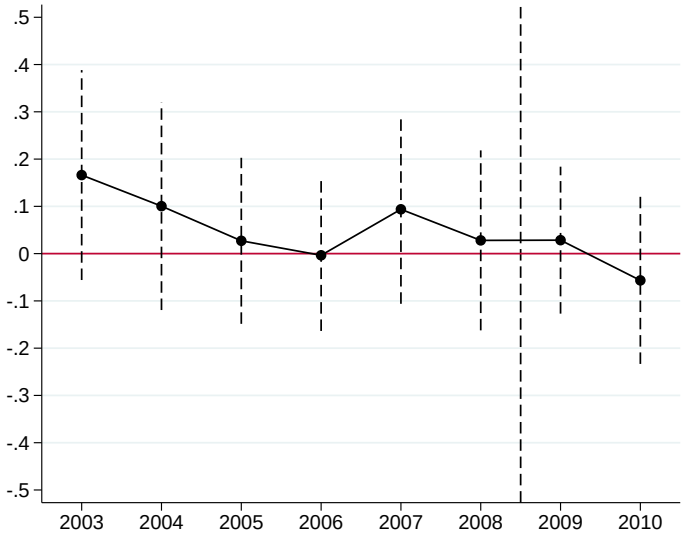

Figure 4: **Event-study specification on dropout rate: Social Science and Humanity vs. Medical School and Science**

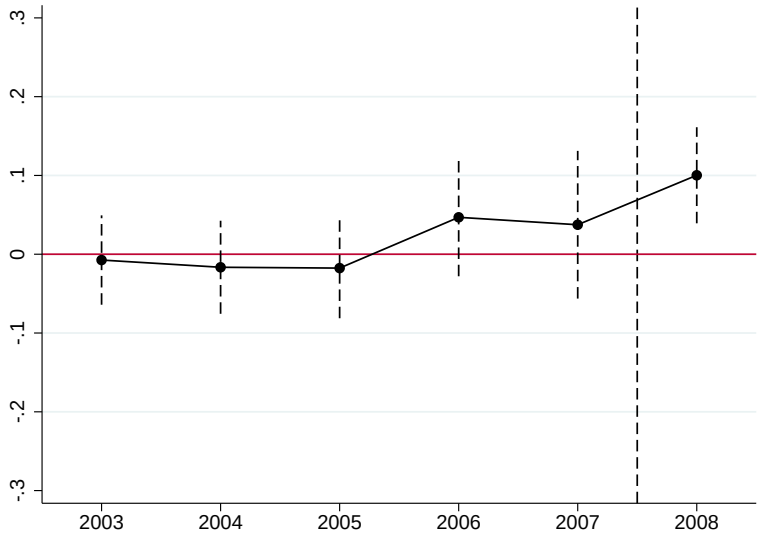

Figure 5: **Event-study specification on graduation rate: Social Science and Humanity vs. Medical School and Science**

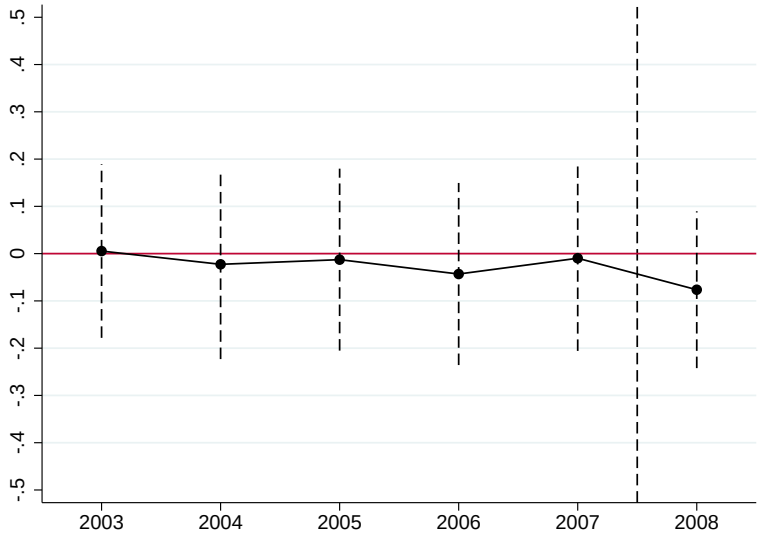

Figure 6: **Event-study specification on graduation on time rate: Social Science and Humanity vs. Medical School and Science**