Do reforms aimed at reducing time to graduation work? Evidence from the Italian higher education system*

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Abstract

This paper examines the impact of a reform aimed at expediting graduation times in Italian universities by reducing the number of exams students must pass to obtain a fixed number of credits. Using event-study estimates that leverage the reform's staggered implementation, we find that this policy change led to an increase in on-time graduation rates. However, it also resulted in a decreased probability of employment one-year post-graduation. This negative effect vanishes in the medium run, suggesting that the reform's compliers—students who managed to graduate on time under the new regime but would have been delayed in the pre-reform regime—might have engaged in less intensive job search efforts immediately after graduation.

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1 Introduction

Completing a college degree within standard completion time is becoming increasingly uncommon. In 2008, only 44% of first-time U.S. bachelor's degree recipients completed their degree within four years (Cataldi et al., 2011), a trend that has been on the decline for decades, both in the U.S. and across Europe (Bound et al., 2012; Brunello and Winter-Ebmer, 2003).

This trend has been recognized by policymakers (e.g., U.S. Department of Education, 2016) but has received limited attention from economists. Related studies mostly focus on the determinants of increased time to graduation (e.g., Garibaldi et al., 2012) and highlight the costs associated with staying an extra year in college: more tuition to be paid and delayed entry in the labor market (Dynarski, 2016; Oreopoulos and Petronijevic, 2013; Bound et al., 2012). However, a longer time to graduate could also have positive effects on labor market outcomes, particularly if students use that extra time to increase their human capital. It is therefore hard to know, ex-ante, whether policies aimed at reducing time to graduate—which are often debated by policymakers, see for instance Johnson (2011)—ultimately lead to improved labor market prospects.

This paper studies the labor market consequences of an Italian reform signed into law in 2004 that attempted to reduce time to graduation by harmonizing the course offerings across all universities. Before this reform, all students had to obtain a predetermined number of credits to get a degree. This number of credits was common across all universities (120 credits) but each institution was free to decide the number of courses (and thus exams) students must pass to obtain the necessary credits. As a result, the number of exams required for the same degree could differ significantly between universities. For example, it was possible to observe one student having to pass 20 exams to obtain their degree whereas another student in a different university could obtain the same degree after passing only 12 exams.

The reform forced all universities to offer at most 12 courses to obtain the necessary 120 credits.[1] This was achieved by consolidating the course offerings. If before the reform a student would have to pass two, somewhat similar, exams to obtain 10 credits, now after the reform the

[1]This reform is therefore different from the one analyzed by Arteaga (2018). She studies a reform that reduces the required credits for an Economics degree at Universidad de Los Andes (Colombia) up to 20% . The reform studied here instead does not alter the number of credits—which remained fixed at 120 before and after the reform.

student has to pass only one exam to obtain the 10 credits. This could speed up graduation time because in Italy university students decide when to take an exam. The pre-reform student might therefore decide to take one exam in the fall session and the other exam in the following spring session thus potentially delaying their graduation date.

We study the effects of this reform using data for (close to) the universe of Italian university students. We have access to the labor market outcomes of these students via follow-up surveys conducted 1, 3, and 5 years after graduation. The staggered implementation of the reform across universities and majors enables a policy evaluation of the reform via a difference-in-differences approach where changes in outcomes for cohorts of students affected by the reform are compared to changes in outcomes of cohorts of students still enrolled under the pre-reform regime.

We find that the reform successfully streamlined course structures and significantly increased on-time graduations, with immediate post-reform cohorts experiencing a 4.2 percentage point increase in on-time graduation rates (from a pre-reform rate of about 39%). This effect is even stronger in later cohorts, with increases up to 12.7 percentage points. However, the reform significantly reduced the likelihood of being employed one year after graduation and also had a negative, but noisier, effect on earnings. These negative effects fade out in the following years, and five years after graduation, the probability of employment for post-reform cohorts is slightly higher (by about 2 percentage points), though these estimates are somewhat imprecise and sensitive to assumptions of how treated and control cohort outcomes would have evolved without the intervention (Rambachan and Roth, 2023).

In terms of mechanisms, the reform did not impact the quantity, quality, and attrition rate of enrolled students, nor did it lead to a decline in the human capital accumulated by students. Post-reform cohorts have similar grades, propensity to study abroad, and completion times for their final thesis as pre-reform cohorts. In addition, the reform did not significantly impact the likelihood of students having job-related experiences, such as internships, while still in school. Finally, in majors where the reform had no impact on the probability of graduating on time, we observe no change in post-graduation labor market outcomes. Therefore, the primary effect of the reform on short-term labor market outcomes seems to come from its enhancement of students'

probability of graduating on time.

But how can a reform that caused an increase in on-time graduation—a positive signal used by employers to screen between job market candidates (Aina and Casalone, 2020)—lead to *worst* labor market outcomes in the year after graduation? We rule out general equilibrium explanations based on employers decreasing the weight assigned to on-time graduation as a signal to evaluate job market candidates. Instead, our findings suggest that the observed labor market effects are more likely due to changes in graduates' job search behavior.

Compliers of the reform—students who graduated on time under the new regime but would have been delayed in the pre-reform regime—might have used the additional time gained from the earlier graduation toward leisure, thereby reducing their job search efforts immediately after graduation (e.g., they might take a gap year). This explanation aligns with two observations. First, conditional on employment, there are no significant differences in log wages one year after graduation between post- and pre-reform cohorts. Second, the employment probability differences between the treated and control cohorts vanish three and five years post-graduation.

2 Institutional Background

2.1 The Italian Higher Education System

Italy's higher education system follows a "3+2" model, implemented as part of the Bologna Process. This initiative involved a series of reforms undertaken by European countries to harmonize the standards and quality of higher education qualifications across the European Union. In the Italian 3+2 model, a first-level degree (*laurea triennale*, henceforth LT) with a statutory duration of three years is followed by a second-level degree (*laurea specialistica/magistrale*, henceforth LM) with a statutory duration of two years.[2] With this system, students can obtain a bachelor's degree within three years (LT) and combine it with an optional master's degree (LM). Most Italian students with an LT continue their studies and thus enroll in an LM. For instance, in 2014, about 77% of the students graduating from an LT declared that they wanted to continue their

[2]For some degrees, most prominently in law and medicine, there is a single cycle with nominal length equal to five (law) or six (medicine) years, the "*lauree a ciclo unico*".

studies (Alma Laurea, 2014). This figure had been remarkably stable over time—among students obtaining an LT in 2007, it was equal to 78% (Alma Laurea, 2007).

2.2 The Reform

The Bologna Process established that students graduating from an LM must obtain 120 academic credits (180 for LT). However, it also gave significant autonomy to universities in designing their course offerings.[3] As a result, it was entirely possible that one university would require students to take 20 or more courses to obtain the necessary 120 credits, whereas another university would only require them to take just 12 courses.

Many have observed (e.g., Stefani and Zara, 2009) that taking 20 courses instead of 12 often leads to delayed graduation. Unlike the practice in the U.S., in Italy, students are not required to take the exam right after a course ends and can instead decide when to take it. Moreover, they have the option to reject an unsatisfactory grade and retake that exam in the next available exam session.[4] This system, where passing at least one exam per course is necessary to earn credits, combined with the flexibility in exam scheduling and the option to retake exams, can significantly extend the time students take to graduate.

Concerned about the potential impact of this fragmented course offering on graduation times, the Italian government enacted Act 270/04 (henceforth "the reform"). This reform imposed a cap on the number of courses required for graduation without, however, changing the number of credits. The cap was fixed at 20 in an LT (for a total of 180 credits) and 12 in an LM (for a total of 120 credits).[5] Importantly, these new dispositions applied only to new enrollees. Students who enrolled before the new regime was enacted could finish their degree under pre-reform rules.[6] The law only required the universities to complete the reform process by the academic year 2011,

[3] When enrolling in either an LT or LM, students immediately declare their major (e.g., engineering) and field of study (e.g., mechanical engineering).

[4] There are typically three exam sessions, one in the winter, summer, and fall.

[5] The reform also facilitated the transition to a second-level degree by allowing students to enroll in an LM during the academic year and separating the accumulation of credits across LT and LM (see chapter 1.3.2 of Stefani and Zara, 2009).

[6] Although students can switch between regimes, this possibility may be complicated and costly (Stefani and Zara, 2009). Thus, the fraction of "switchers" is small, and we drop these few cases when building our final estimation sample.

resulting in the reform's staggered implementation across both universities and majors.

2.3 Implications of the Reform on Course Offerings, Graduation Time, and Labor Market Outcomes

Appendix Table A.1 provides some qualitative evidence on how course offerings were changed following the reform's passage. The table shows the list of courses required to graduate with a degree in economic science from the University of Tor Vergata—a large public university in Rome—before and after the reform. Post-reform, the number of courses required to graduate dropped from 20 to 12, while the total number of credits remained the same.

The re-structuring induced by the reform appears to follow a "clustering rule": two previously separated courses (e.g., growth theory and development economics) were now merged into one (called "development"). As a result, a student under the new regime would only need to pass one qualifying exam instead of two to obtain the necessary credits. Therefore, while the post-reform student might just take this exam, say, in the fall exam session, the pre-reform student might instead decide to take one exam in the fall session and the other exam in the following spring session, thus delaying their graduation.

However, whether this reform was successful in reducing graduation time is ultimately an empirical question (e.g., the post-reform student can instead decide to take the now longer and potentially more complex exam on development in the spring as opposed to the fall). Even more uncertain is an ex ante evaluation of the impact of this reform on labor market trajectories. The changes to the course structure induced by the reform—as summarized in Table A.1—can directly impact students' human capital and thus labor market outcomes. Moreover, the reform's direct effect on graduation timing could in turn significantly impact post-graduation labor market outcomes, with effects that are challenging to predict ex ante. While employers might construe delayed graduation as a negative signal when assessing a candidate's potential in the labor market, this delay could be indicative of the student's greater investment in human capital.

3 Data

Our data come from the Alma Laurea (AL) consortium. In 2014, 91% of the Italian college graduates population got their degree from a university that belongs to the AL consortium. The AL data combine three sources: (i) administrative data provided by the universities (e.g., duration of studies, reform status, field of study, university, and year of enrollment); (ii) additional student demographics (e.g., province of residency, parents' education); and (iii) follow-up surveys one, three, and five years after graduation on labor market outcomes.

Our core estimation sample includes 221,336 students who graduated with an LM between 2007 and 2014, had non-missing values on for several key baseline characteristics (e.g., information on whether the student is studying under the new reform), and responded to all follow-up surveys on their labor market outcomes conducted one, three, and five years post-graduation.[7] We focus on LM graduates because (i) the vast majority of students completing an LT enroll in an LM (as noted in Section 2.1), and (ii) we have information on labor market outcomes post-graduation for a large set of individuals graduating from an LM (whereas for most LT graduates, this information is not readily available as the majority would still be in school).

Because the AL samples students who eventually graduate, we do not observe students who enrolled but did not complete their degree, either because they are still enrolled in school or because they dropped out.[8] To assess whether the reform impacted attrition rates, we combine the AL data with additional administrative data from the Italian Ministry of Education, University, and Research (MIUR), which provides counts of all students who enroll in a given year $\times$ major $\times$ university combination.[9]

[7] One year post-graduation, the response rate is 88%. Three years post-graduation, it drops to 78%, and five years post-graduation, it further decreases to 70%. The overall response rate for all follow-up surveys is 58.7%, seemingly unaffected by the reform. Notably, response rates remain high even five years after graduation, likely because AL is one of the largest online job boards in Italy (Bagues and Labini, 2009). The motivation for students to fill out the AL questionnaire stems from the opportunity to upload their CV to a database at no cost. This database is used by both national and international firms to screen for potential employees.

[8] This provides another reason for focusing on LM students as the attrition rates in LMs are approximately half of those observed for students enrolling in a first-level degree (see Torrini, 2013).

[9] A major (*gruppo disciplinare*) is a category that contains several fields of study. For instance, "economics-statistics" is a major that contains fields of study such as "economic science," "finance," and "management." Our definition of majors follows that of the Italian National Statistic Institute (ISTAT) used also by the MIUR and includes the following: scientific, chemistry-pharmaceutical, geo-biological, medical, engineering, architecture,

3.1 Summary Statistics

Table 1 provides summary statistics for our sample. Around 41% of students graduate under the new regime established by the reform. The table shows minimal differences between pre- and post-reform students in terms of pre-determined characteristics. For instance, grades do not appear to change systematically between pre- and post-reform cohorts, suggesting that the reform did not systematically change the composition of students.

Nearly 58% of the students are women, entering at an average age of 24. About 13% are international students, 43% attended a scientific high school, 15% attended a humanities high school, and 28% have parents with a college degree. The table also shows the averages of key covariates according to when a student graduates. Around half of the observed students graduate on time, and they tend to have higher prior grades, come from a more favorable socio-economic background (as measured by parents' education), and are less likely to have graduated from a STEM field.

Appendix Table A.2 shows descriptive patterns of the labor market outcomes one, three, and five years after graduation for the sample. Immediately after graduation, 71% of graduates are employed: 25% have permanent positions, 47% work with a temporary employment contract, and 79% are employed full time. Moreover, the average monthly wage (conditional on working) for graduates is slightly above 1,000 euros, consistent with recent figures on job market prospects for younger and more educated generations in Italy (Rosolia and Torrini, 2007). Wages, employment shares, and the percentage of students with a permanent employment contract tend to increase as the years pass following graduation.

4 Research Design

Whether a student is covered by the reform depends on their year of enrollment, major, and university. Figure A.1 illustrates the fraction of students registered under the new reform for a given year of enrollment in an LM. Most universities adopted the new reform during the 2008–

agricultural-veterinary, economics-statistics, political-social, law, literary, education, psychological, and physical education.

2009 biennium. In line with central government requirements, by 2011, nearly all students in the AL database were studying under the new regime.

The reform's staggered implementation can be leveraged in an event-study framework as follows:

$$y_i = \alpha_{f(i),u(i)} + \lambda_{u(i),c(i)} + \sum_{j=a}^{b} \beta_j R^j_{f(i),u(i),c(i)} + X_i^\top \gamma + r_i, \tag{1}$$

where y_i represents an outcome of interest of student i, $c(i)$ denotes of their year of enrollment, $u(i)$ represents their university, and $f(i)$ denotes their field of study. Therefore, $\lambda_{u(i),c(i)}$ controls for year of enrollment $\times$ university fixed effects, while $\alpha_{f(i),u(i)}$ controls for field of study $\times$ university fixed effects.[10] X_i includes a set of student demographics used to increase our estimates' precision.[11] Standard errors are clustered at the university level (there are 64 universities in our estimation sample).

The term $R^j_{f,u,c}$ is an event-study indicator, i.e., $R^j_{f,u,c} = E_{f,u}\mathbb{1}\{c = c^*_{f,u} + j\}$, where $E_{f,u}$ is a dummy for whether the field of study f in university u implemented the reform, and $c^*_{f,u}$ represents the year in which the reform was implemented in a particular field by university u.[12] The coefficients of interest, β_j, for $j \geq 0$, capture the effects of the reform under the assumption that differences in outcomes between cohorts that enrolled before or after the implementation would have remained constant in the absence of the policy. One can gauge the plausibility of this parallel trends assumption by comparing the relative changes in outcomes of the cohorts of students who enrolled in different years in the pre-reform regime, i.e., by evaluating the pre-trends coefficients β_j for $j < 0$ in equation (1).

To deal with potential violations of the parallel trends assumption, we use the estimates of β_j for $j < 0$ to construct a linear time trend based on data from pre-reform cohorts only. We

[10] The staggered adoption of the reform across universities, as well as majors/fields of studies (even within the same university) allows for a scenario where two students enrolled in the same year and university, but in two different fields of studies, could be subject to either the pre-reform or post-reform regime. This allows us to flexibly control for university $\times$ cohort of entry fixed effects in equation (1).

[11] These controls include gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high school, and an indicator for whether the province of residence is the same as the province of study.

[12] About 7% of the field by universities in our data are only observed in the pre-reform regime. Around 2% are only observed in the post-reform regime, and the remaining 91% switched at some point from the pre-reform to the post-reform regime.

then report deviations of β_j from this linear time trend, extrapolated to post-reform years, to assess any breaks in outcomes following the reform's implementation (for a similar approach, see Dustmann et al., 2022). Finally, to assess the robustness of the results to alternative assumptions about how outcomes would have evolved for pre- and post-reform cohorts without the reform, we report the bounds from the "honest approach" to parallel trends outlined by Rambachan and Roth (2023).

5 Results

5.1 The Reform's Impact on Number of Exams Taken and On-Time Graduations

We begin by examining the impact of the reform on the number of exams taken by pre-reform and post-reform cohorts. Figure 1 displays estimates from equation (1) for two different outcomes: an indicator of whether students took more than 12 exams (panel (a)), and the total number of exams taken by students (panel (b)).[13] Two key observations stand out. First, pre-reform cohorts show a stable trend in the number of exams taken, indicating that the reform's introduction was largely unanticipated by students and institutions alike. Second, the reform is linked to significant changes in course structure, as evidenced by the substantial reduction in the number of exams. Specifically, for the first cohort under the new regime, there is a notable decrease of approximately 55 percentage points in the proportion of students taking more than 12 exams—a 63% reduction from the 87% share of students taking more than 12 exams observed in the last pre-reform cohort. Additionally, there is an average drop of roughly 5 exams from a baseline average of 17.2 exams. This suggests that the reform successfully streamlined the course structure.

Figure 2 shows the reform's impact on graduation rates. Panel (a) provides estimates on the proportion of students graduating on time, defined as those completing their studies within two years of initial enrollment. Panel (b) reports the results on the proportion graduating within three years, while panel (c) provides estimates on graduation rates (i.e., number of students

[13] Appendix Table A.3 reports event estimates at $j = 0$ and $j = 3$ from equation (1) on the probability of taking more than 12 exams and on the number of exams. Appendix Figure A.2 shows the sensitivity analysis based on Rambachan and Roth (2023).

graduating divided by number of students enrolling).[14] Differences in graduation rates seem to trend positively in the years leading up to the implementation of the reform. To account for these trends, a linear time trend estimated from the pre-reform data and extrapolated into subsequent years is depicted as a dashed line to the left of each panel. The deviations between actual coefficient estimates and this linear trend are shown in the graphs to the right of each panel.

We find that the reform sharply increased the share of on-time graduates. For the first cohort of students enrolling in the new regime, the share of on-time graduates increases by 4.2 percentage points. For the last observed cohort of post-reform students, the increase is higher, around 12.7 percentage points (the fraction of on-time graduates in the last pre-reform cohort is 39%). When we consider students graduating within three years from initial enrollment, the graduation rate increases from 2.8 to 6.3 percentage points, depending on the cohort analyzed.[15] Moreover, the reform had no significant effect on attrition rates, as shown in Figure 2, panel (c). This finding simplifies the interpretation of the results on labor market outcomes (presented in the next section) since the AL collects data on labor market outcomes conditional on graduation.

To summarize, the empirical evidence suggests that the reform led to a large restructuring and harmonization of Italian universities' course offerings. While this change did not impact whether students graduated, it did impact when they graduated. In particular, the rate of on-time graduation increased significantly after the reform, consistent with its initial intent (Stefani and Zara, 2009).

5.2 Reform's Impact on Labor Market Outcomes

Figure 3 reports the results on labor market outcomes. Panel (a) shows that exposure to the reform substantially decreased the probability of employment one year after graduation, with an impact ranging from 1.7 percentage points one year post-reform to almost 10 percentage points

[14] Appendix Table A.4 reports estimates at $j = 0$ and $j = 3$ from the event studies shown in Figure 2.

[15] Figure A.3 reports estimates from the honest approach to parallel trends, proposed by Rambachan and Roth (2023), to probe the robustness of our findings to alternative assumptions about different trends in pre- and post-reform cohorts that would emerge in the absence of the reform. When considering the average effects through post-reform event-study coefficients, we find that the effect remains positive and statistically significant, up until the point where large deviations from the differences found between pre-reform cohorts are considered. In particular, the average impact of the reform on-time graduation rate becomes insignificant for a value of $M = 0.01$, which corresponds to a $\pm 33\%$ deviation per cohort from the linear trend found in the pre-reform era.

three years later, compared to a baseline employment probability of 72%. A similar pattern is also found when evaluating the earnings of students one year after graduation, albeit the estimates are somewhat noisier.

However, we do not find these negative effects five years post-graduation.[16] If anything, the post-reform cohorts seem to have slightly better labor market outcomes (both in terms of employment and earnings), with the caveat that these estimates are only marginally significant and are sensible to alternative assumptions on the evolution of outcomes between treated and control cohorts in the absence of the reform (see Figure A.4).

In sum, the reform negatively affected labor market outcomes one year after graduation. However, this negative shock faded out over time, turning into a null or marginally positive effect on both employment and earnings.

6 Mechanisms

In interpreting the findings depicted in Figures 2 and 3, a key consideration is whether the observed short-term negative effects on employment stem from the reform-induced changes in on-time graduation rates, or from other factors influenced by the reform but unrelated to on-time graduation. Section 6.1 provides evidence against the latter interpretation. Section 6.2 argues that the negative short-term effects on employment are driven by the reform's compliers—students who graduate on time due to the reform but would have otherwise graduated late—reducing their job search efforts immediately after graduation, relative to the counterfactual where they graduate later.

6.1 Channels Unrelated to On-Time Graduation

Selection. The reform aimed to facilitate student enrollment in an LM (Stefani and Zara, 2009). As a result, it might have shifted the composition of students, potentially impacting the

[16] The results on labor market outcomes at three years post-graduation show marginal increases compared to one year after graduation but are generally not statistically significant. For simplicity, these findings are not included in the paper but are available upon request. Appendix Table A.5 reports event estimates at $j = 0$ and $j = 3$ from equation (1) on the probability of working and earnings.

labor market trajectories of post-reform cohorts. However, we find little evidence in favor of this interpretation. Table 1 shows minimal differences between pre- and post-reform students across various pre-determined characteristics that are good predictors of post-graduation labor market outcomes, such as age at enrollment or grades in high school and during the LT. Moreover, Figure A.5 shows the reform's impact on LM enrollment numbers. The event-study estimates show no significant changes for all but the final post-reform cohort, but only marginally. The magnitude of the average effect is economically small and not statistically different from zero when allowing for minimal alterations to the linear trend extrapolation (see the bounds based on the approach of Rambachan and Roth (2023) displayed in Figure A.5, panel (c)). This lack of significant change in the student composition aligns with the reform's null impact on attrition rates (see Figure 2, panel (c)).

Crowding-out effects. As discussed in Section 5.1, the reform did not increase graduation rates. This finding, combined with the aforementioned negligible impact on enrollment numbers, suggests that crowding-out effects—which could explain some of the negative short-term outcomes—are unlikely. The reduced impact of the reform over the medium term further diminishes the likelihood of such effects, contrasting with the crowding-out effects observed in another major educational reform in Italy, as documented by Bianchi (2020).

Human capital. While the reform did not change the number of credits necessary for a degree, its changes to course structure—as shown in Appendix Table A.1—might decrease the human capital of post-reform students, similar to what happened in Arteaga (2018). However, our findings do not support this interpretation. Appendix Figure A.6 indicates no significant effect of the reform on proxies that could measure the quality of human capital accumulated by students, such as final LM grades, LM exam GPAs, final thesis completion times, and the likelihood of studying abroad (*Erasmus*).[17] Additionally, Appendix Figure A.8 shows that the reform had no

[17]In the Italian academic system, the final LM grade is assigned on a scale ranging from 66 to 110, whereas exams are graded on a scale from 18 to 30 points. The final LM grade is assigned based on the GPA of the exams and the quality of the final thesis. Submitting a final thesis is required for all LM students. Appendix Table A.7 reports the sensitivity test based on Rambachan and Roth (2023).

significant impact on the probability of working while in school. Taken together, this evidence contrasts with the idea that the reform reduced students' human capital. The diminishing impact on post-graduation labor market outcomes (being negative in the first year from graduation but nearly zero after five years) is difficult to align with a standard model where human capital effects are expected to be persistent.

Heterogeneity across majors. Figure 4, panel (a) reports the coefficients β_j for $j \geq 0$ from equation (1), on the probability of employment one-year post-graduation (y-axis) against the reform's effect on on-time graduation rates (x-axis) for a given major observed in our data. Panel (b) follows a similar approach but focuses on earnings. In majors where the reform had no impact on the probability of graduating on time, we observe no effects on labor market outcomes. Negative short-term effects are seen only in majors where the reform had a large impact on the probability of graduating on time, reinforcing the interpretation that other factors are not responsible for the reform's negative effects on short-term labor market outcomes.

6.2 Channels Related to On-Time Graduation

On-time graduation is a positive signal used by employers when evaluating job market candidates.[18] However, despite increasing on-time graduation rates, the reform appears to have a negative effect on employment probabilities one year after graduation. We consider two alternative theories—one based on labor demand, the other on labor supply—that could rationalize this finding.

Employers. By increasing the number of students graduating on time, the reform has potentially decreased the value of on-time graduation as a signal for employers to assess student quality (Farber and Gibbons, 1996).[19] Therefore, when facing post-reform graduates, firms may be more

[18] Cross-sectional regressions of earnings post-graduation on an indicator of on-time graduation rate show an economically and statistically strong coefficient, even when this regression controls flexibly for fields of studies × university fixed effects and other student characteristics such as high school grades, age upon initial enrollment, and gender (see also Aina and Casalone, 2020).

[19] On-time graduation is an easy-to-observe signal for employers and is directly available to those hiring via the AL job board.

likely to converge to a pooling type of equilibrium with lower offered wages relative to a counterfactual where they instead use on-time graduation as an effective signal to discriminate between new graduates (Spence, 1973). However, Appendix Figure A.9 provides evidence partly at odds with this interpretation. Conditional on having a job, post-reform cohorts do not seem to receive a systematic lower wage one-year post-graduation.

Students. Post-reform cohorts differ from pre-reform cohorts on two key margins: (i) the share of on-time graduates and (ii) the probability of employment one year after graduation. Conditional on having a job, treated cohorts are not systematically different from control cohorts in terms of log wages, as shown in Appendix Figure A.9. Moreover, five years after graduation, differences in the extensive margin between post- and pre-reform cohorts vanish. A plausible explanation for this set of findings is that some of the reform's compliers might devote the "extra" time due to an earlier graduation date to leisure. In a counterfactual where they were not exposed to the reform, these individuals would graduate late and as a result might decide to start searching for a job right after graduation to compensate for the delayed entry into the labor market. This interpretation is consistent with two key results. First, Figure A.9 shows the null effects on wages conditional on having a job one year post-graduation, suggesting that the negative short-term labor market effects are primarily driven by the extensive margin. Second, the dynamic effects found in Figure 3 show no systematic differences in employment probabilities five years after graduation, consistent with the idea that compliers temporarily reduce their search intensity and only in the immediate aftermath following their (earlier) graduation.

7 Conclusion

In our evaluation of an Italian university reform aimed at consolidating course offerings to decrease time to graduation, we find that the reform successfully streamlined course structures and increased the on-time graduation rate. However, it also adversely impacted labor market outcomes for graduates one-year post-graduation, with these negative impacts gradually diminishing and disappearing by the five-year mark. Changes in student composition, reductions in

human capital, and shifts in how firms use on-time graduation to screen job market candidates are unlikely to be the primary drivers of the observed short-term negative employment outcomes. Instead, these trends may be explained by a tendency among compliers of the reform to delay job searches immediately after graduating, potentially opting for a gap year before entering the labor market.

Our results are externally valid to similar European higher education systems and countries implementing similar reforms. A key takeaway from our study is the importance for policymakers to carefully consider the potential behavioral responses of students to educational reforms, particularly those that may shift the probability of earlier graduation.

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Figures and Tables

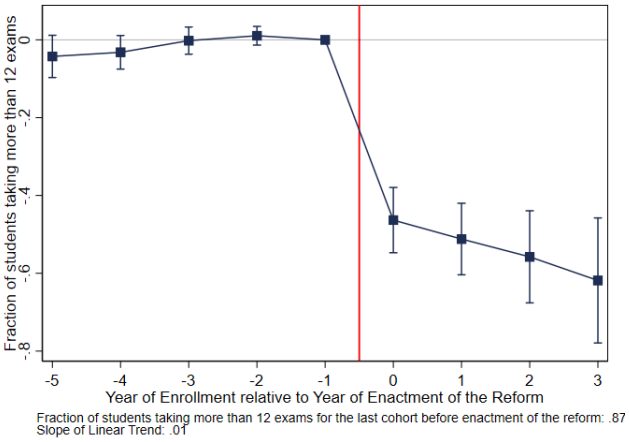
Table 1: Summary Statistics

	Regime Status		Graduation Time		
Variable	Pre-Reform	Post-Reform	On-time	1yr Late	2yrs Late or more
Share	0.59	0.41	0.52	0.34	0.14
Background Characteristics					
Age at Enrollment	24.13	24.13	24.15	23.85	24.72
	(4.63)	(4.46)	(5.02)	(3.72)	(4.51)
Female	0.58	0.60	0.60	0.57	0.56
Foreign	0.01	0.02	0.01	0.01	0.02
Scholarship	0.22	0.22	0.23	0.23	0.18
High School Grade	85.88	85.48	86.23	85.57	84.19
	(12.15)	(12.20)	(12.22)	(12.03)	(12.21)
Grade (LT)	101.55	101.07	101.99	100.87	100.19
	(9.01)	(9.30)	(9.22)	(8.80)	(9.39)
Scientific HS	0.43	0.43	0.44	0.43	0.40
Letters HS	0.16	0.15	0.15	0.16	0.15
STEM Field	0.32	0.30	0.29	0.34	0.34
Same Province	0.46	0.45	0.45	0.46	0.49
Parent's College	0.28	0.29	0.29	0.28	0.26
Total Number of Students	221,336				
Number of Fields x Universities	1,733				

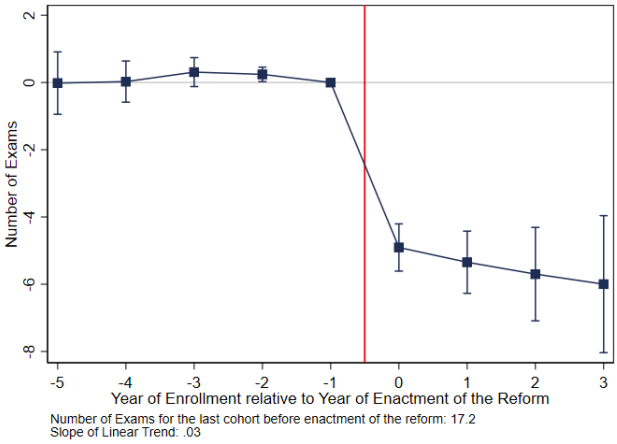
Note: This table provides summary statistics for the sample of students who graduated with a second-level degree "Laurea Magistrale" (LM) in the Alma Laurea data between the years 2007-2014 and who responded to all post-graduation surveys conducted by Alma Laurea 1, 3, 5 years after graduation. The first row reports the shares corresponding to the variable indicated in each column. For instance, 0.59 corresponds to the fraction of students in our sample who graduated under the pre-reform regime. Grade (LT) is the final grade obtained by the student when graduating from the first level degree, denoted as LT (*Laurea Triennale*). Same province is an indicator of whether the student's resident address is in the same province as the university that they attend. Standard deviations are in parenthesis.

Figure 1: The Impact of the Reform on the Number of Exams

(a) Taking more than 12 Exams



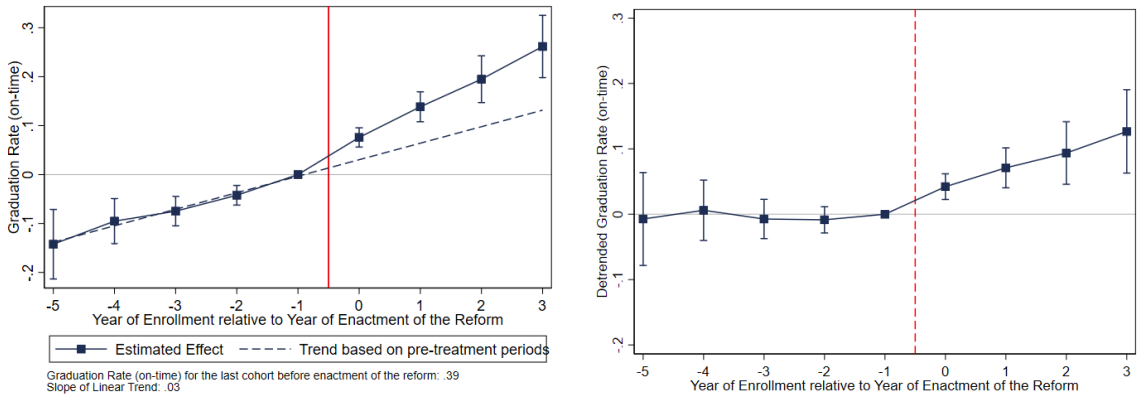
(b) Number of Exams



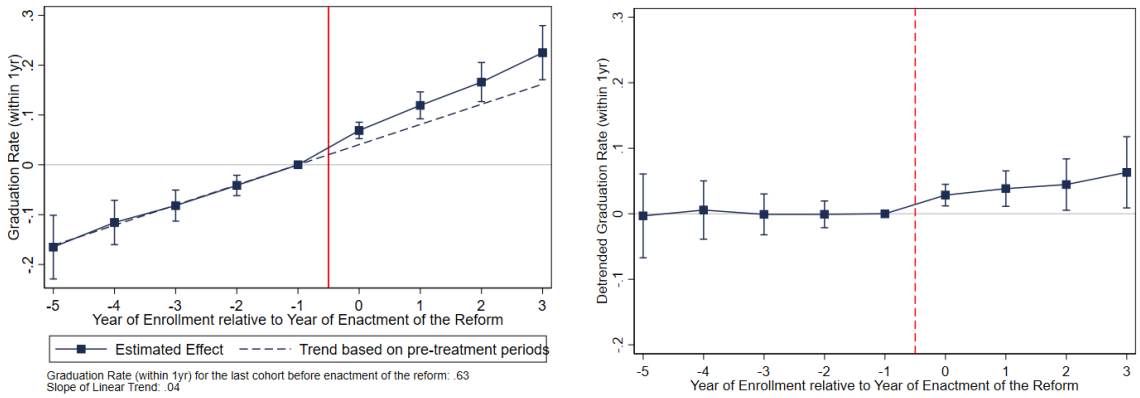
Note: This figure reports estimates from equation (1). In panel (a), the outcome is an indicator for whether the student took more than 12 exams. In panel (b), the outcome is the total number of exams taken. The regression controls for university by field of study fixed effects and university by year of enrollment fixed effects as well as students' pre-determined characteristics (gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high-school, and an indicator for whether the province of residence is the same as the province of study). Event-study estimates are normalized relative to the cohort of students that enrolled in the year prior to the enactment of the new regime. The straight line indicates the first entry cohort that studies under the new reform. Below each graph, we report the slope of the pre-event event-study coefficients as well as the average of the outcome variable for the last cohort of students who enrolled in the pre-reform regime. 95% confidence intervals are obtained after clustering the standard errors at the university level.

Figure 2: The Impact of the Reform on Time to Graduation and Graduation Rates

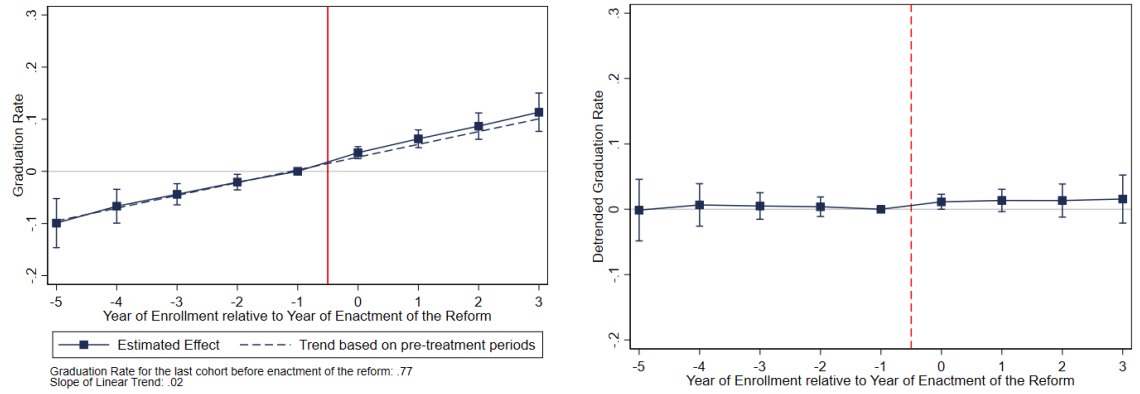
(a) Fraction of Students Graduating in Two Years or Less (On-Time Graduation)



(b) Fraction of Students Graduating in Three Years or Less



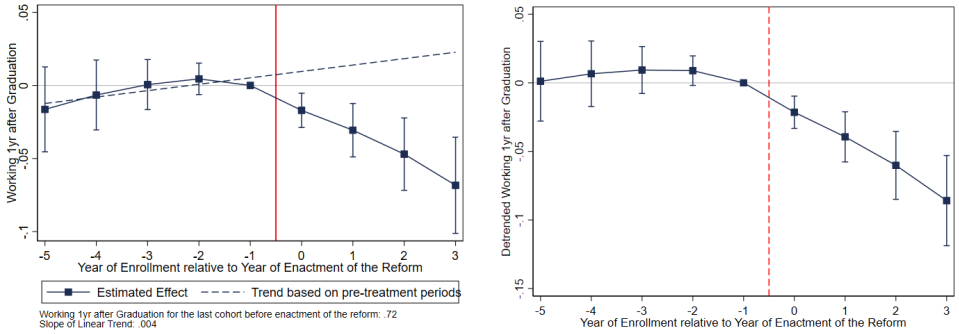
(c) Graduation Rate



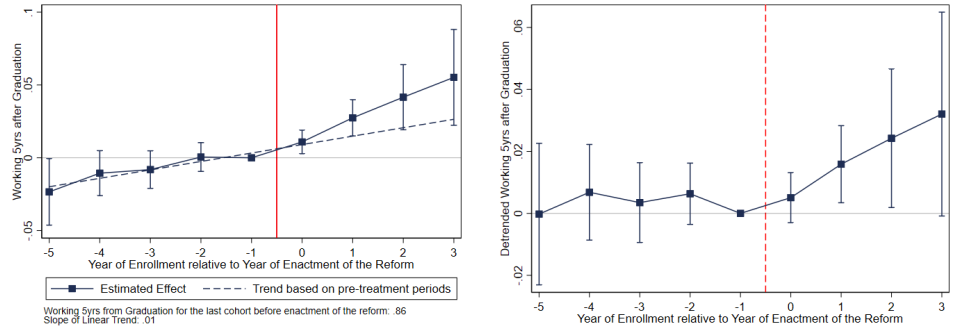
Note: This figure reports estimates from a version of equation (1) collapsed at the university × major × year of enrollment that controls for university by major and university by year of enrollment fixed effects. Majors are groups of fields of study defined by Italian National Statistic Institute (ISTAT) and include: Scientific, Chemistry-Pharmaceutical, Geo-Biological, Medical, Engineering, Architecture, Agricultural-Veterinary, Economics-Statistics, Political-Social, Law, Literary, Education, Psychological, and Physical Education. In panel (a), the outcome is the fraction of students graduating on-time, i.e. the fraction of students that obtained their degree within the nominal duration of an LM degree (which is two years). In panel (b), the outcome is the fraction of students that graduated in three years. In panel (c), the outcome is the fraction of students graduating. For all these outcomes, the denominator is represented by the number of students *enrolling* in a given year × major × university. Estimates are weighted by the number of enrolled students. On the left, we report the linear trend estimated using pre-reform event-study coefficients only which is then extrapolated to post-reform cohorts. On the right, we report the deviations from the event-study coefficients to this linear time trend. Figure A.3 reports estimates from the "honest approach" to parallel trends proposed by Rambachan and Roth (2023) to probe the robustness of our finding to alternative assumptions about different trends between pre-reform and post-reform cohorts that would have emerged in the absence of the reform. Event-study estimates are normalized relative to the cohort of students that enrolled in the year before the enactment of the new regime. The straight line indicates the first entry cohort that studies under the new reform. Below each graph on the left, we report the slope of the pre-event event-study coefficients as well as the average of the outcome variable for the last cohort of students who enrolled in the pre-reform regime. 95% confidence intervals are obtained after clustering the standard errors at the university level.

Figure 3: The Impact of the Reform on Post-Graduation Labor Market Outcomes

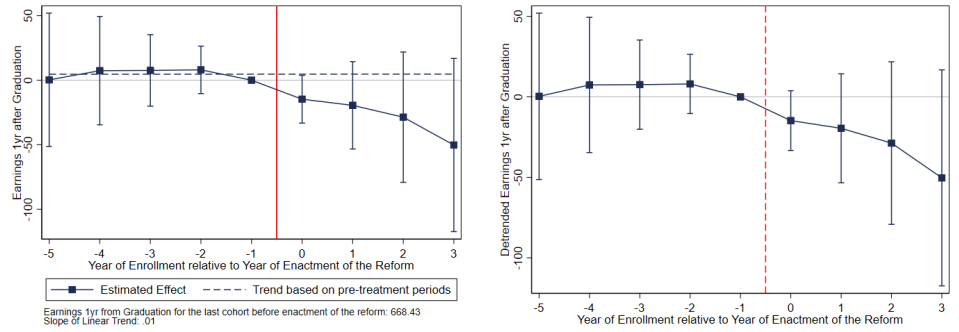
(a) Probability of Working - 1yr After Graduation



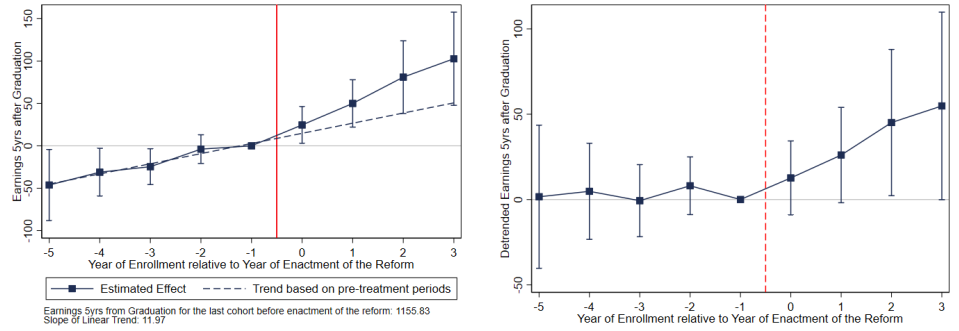
(b) Probability of Working - 5yrs After Graduation



(c) Earnings - 1yr After Graduation



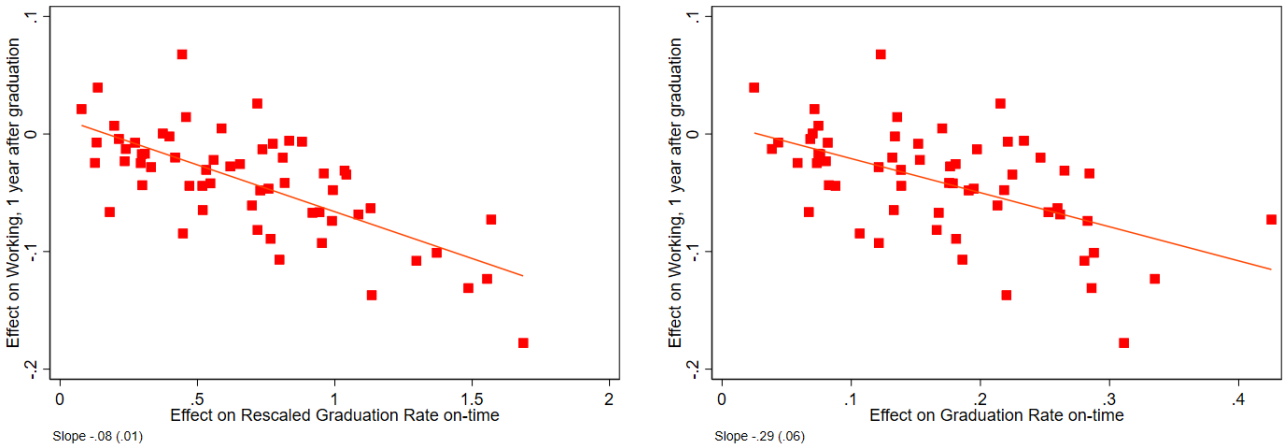
(d) Earnings - 5yrs After Graduation



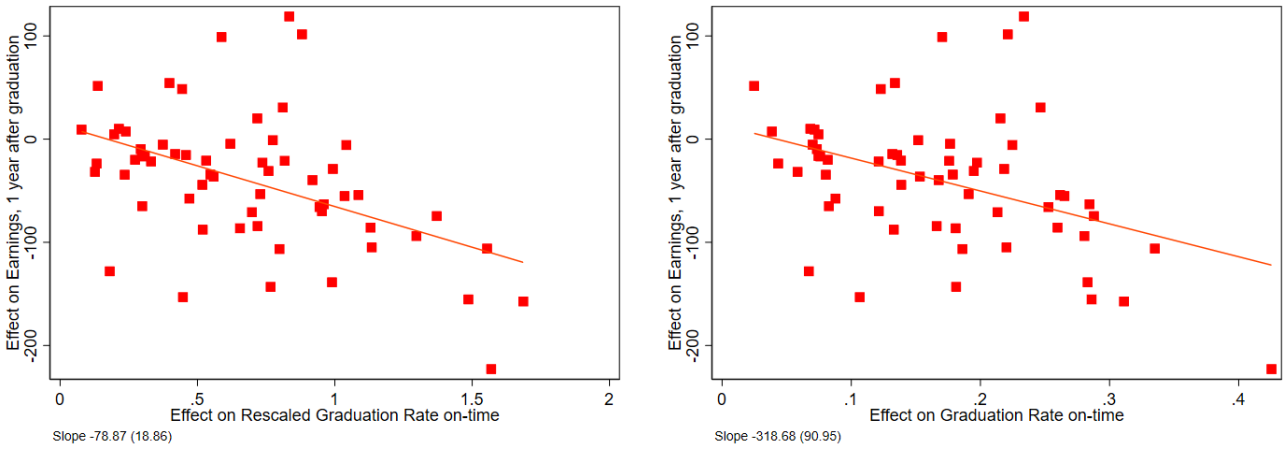
Note: This figure reports estimates from equation (1). In panels (a) and (b), the outcome is an indicator equal to 1 if the worker has a job one year after graduation (panel a) or 5 years after graduation. This indicator is equal to zero if the student remains in school (e.g., the student is enrolled in a master's program or a PhD). Panel (c) and (d) are similar but look at earnings (with earnings set equal to zero for students not working or missing if the student decides to not disclose their earnings to Alma Laurea if employed). On the left, we report the linear trend estimated using pre-reform event-study coefficients only which is then extrapolated to post-reform cohorts. On the right, we report the deviations from the event-study coefficients to this linear time trend. Figure A.4 reports estimates from the "honest approach" to parallel trends proposed by Rambachan and Roth (2023) to probe the robustness of our finding to alternative assumptions about different trends between pre-reform and post-reform cohorts that would have emerged in the absence of the reform. The regression controls for university by field of study fixed effects and university by year of enrollment fixed effects as well as students' pre-determined characteristics (gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high-school, and an indicator for whether the province of residence is the same as the province of study). Event-study estimates are normalized relative to the cohort of students that enrolled in the year before the enactment of the new regime. The straight line indicates the first entry cohort that studies under the new reform. Below each graph on the left, we report the slope of the pre-event event-study coefficients as well as the average of the outcome variable for the last cohort of students who enrolled in the pre-reform regime. 95% confidence intervals are obtained after clustering the standard errors at the university level.

Figure 4: Heterogeneity Analyses Across Majors

(a) Probability of Working - 1yr After Graduation



(b) Earnings - 1yr After Graduation



Note: Each figure reports the post-reform coefficients on the probability of having a job one year after graduation (y-axis) and the effect of the reform on the probability of graduating on time (x-axis) for a given major observed in our data. Panel (b) is similar but focuses on earnings. The post-reform, major-specific, coefficients depicted in each scatter plot are obtained by running an augmented version of equation (1) that reads as follows:

$$y_i = \alpha_{f(i),u(i)} + \lambda_{u(i),c(i)} + \sum_{j=a}^{b} \beta_j R^j_{f(i),u(i),c(i)} + \sum_{j=a}^{b} \theta_j \left(R^j_{f(i),u(i),c(i)} \times M_i\right) + X_i^\top \gamma + r_i \tag{2}$$

where M_i is an indicator equal to 1 when considering a given major. We estimate this equation for each of the following majors: Scientific, Chemistry-Pharmaceutical, Geo-Biological, Medical, Engineering, Architecture, Agricultural-Veterinary, Economics-Statistics, Political-Social, Law, Literary, Education, Psychological, and Physical Education. The scatter plots report the linear combination given by $\phi_j \equiv \beta_j + \theta_j$ for $j \geq 0$ for the aforementioned majors. We also report the associated linear fit (which includes a constant) and print below each graph the associated slope and robust standard error. In the graphs on the left, the graduation rate is rescaled by the graduation rate in the year prior to the reform's enactment (i.e., 2007) to enhance comparability across the various majors. Conversely, the graphs on the right display results using the unscaled measure of graduation rate.

Appendix. Additional Figures & Tables

Table A.1: Changes in the Course Structure Induced by the Reform

University of Rome - Tor Vergata			
Economic Science - Pre Reform		Economic Science - Post Reform	
Name of the Exam	N. of Credits	Name of the Exam	N. of Credits
Game Theory	5	Game Theory	5
Information Economics	5	Information Economics	5
Economic History	5	Economic History	5
Mathematical Methods for Economics	5	Mathematical Methods	10
Optimization	5	- Mathematics for Economics	
Public Finance	5	- Optimization	
Macroeconomics	5	Macroeconomics	5
International Economics	5	International Economics	5
Statistical Methods for Economics	5	Statistical Methods	10
Econometrics	5	- Statistics	
Growth Theory	5	- Econometrics	
Development Economics	5	Development	10
Monetary Economics	5	- Growth Theory	
International Monetary Economics	5	- Development Economics	
Competition Law	5	International Monetary Economics	5
Corporate Law	5	Law of Economics Activities	10
Administrative Law	5	- Competition Law	
International Accounting	5	- Corporate Law	
Finance and Governance	5	Accounting	10
Management of Service Firms	5	- International Accounting	
		- Finance and Governance	
		Management of Service Firms	5
		Extra Activities	11
Final Thesis	20	Final Thesis	24
N. of Credits 120		N. of Credits 120	
N. of Exams 20		N. of Exams 12	

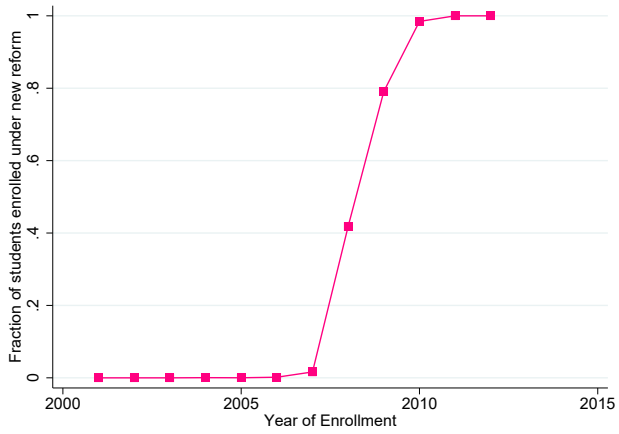
Note: This table lists the courses that a student enrolled in the field of study "Economic Science" in the University of Rome Tor Vergata has to perform if enrolled under the old and the new regime (introduced in the academic year 2009-2010). The plan of study for the student under the pre-reform assumes that the extra exam corresponds to economic history. The plan of study for the student under the new regime assumes that the student takes as optional exam Game theory. The source for this table is the student service of the University of Tor Vergata (Department of Economics and Finance), see
https://economia.uniroma2.it/cdl/biennio/clese/piano-di-studi.

Table A.2: Summary Statistics - Labor Market Outcomes

	Years After Graduation		
Variable	1yr	3yrs	5yrs
Labor Market Condition			
Employed	0.72	0.84	0.86
Additional Information			
Permanent	0.25	0.46	0.62
Temporary	0.47	0.38	0.30
No Contract	0.06	0.03	0.02
Full Time	0.79	0.82	0.84
Monthly Wage	1051.79	1216.65	1383.61
	(504.28)	(517.66)	(556.85)
Total Number of Students	221,336		
Number of Fields x Universities	1,733		

Note: This table provides summary statistics on the labor market outcomes of students who graduated with a second-level degree "Laurea Magistrale" (LM) in the Alma Laurea data between the years 2007-2014 and who responded to all post-graduation surveys conducted by Alma Laurea 1, 3, 5 years after graduation. Standard deviations are in parenthesis. All statistics regarding type of contract, wage, full time, and months to find job are reported only for students who are employed.

Figure A.1: Roll-out of the Reform



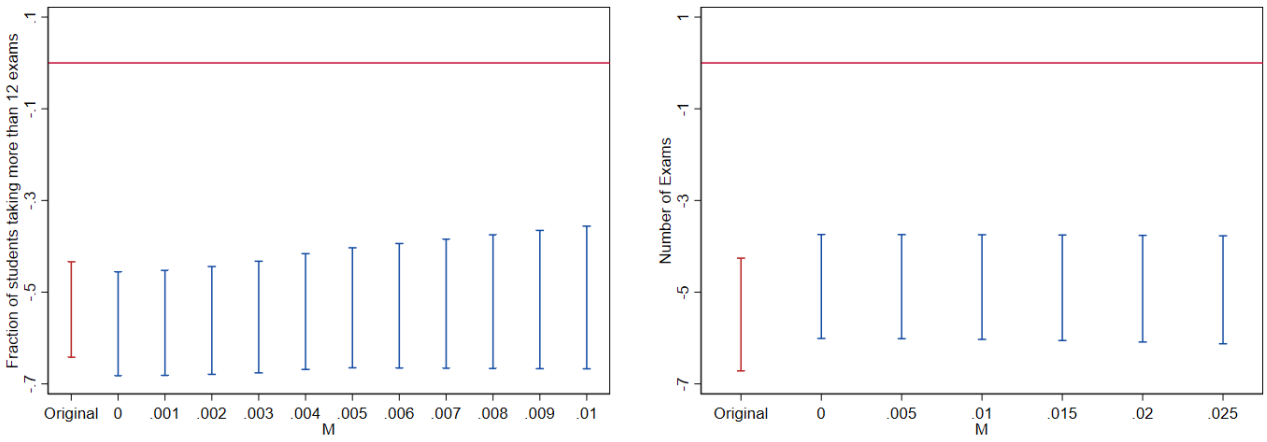
Note: This graph shows, for a given year of enrollment in a LM degree, the fraction of students who are registered under the new reform.

Table A.3: Evidence on the Reform

	(1) Taking More than 12 Exams	(2) Number of Exams
First cohort enrolled in the reform ($j = 0$)	-0.463***	-4.907***
	(0.035)	(0.359)
Last cohort enrolled in the reform ($j = 3$)	-0.618***	-5.998***
	(0.070)	(1.039)
Observations	206,812	206,812
Pre-reform Mean	0.87	17.2
University by Fields of Study FEs	YES	YES
University by Cohorts of Entry FEs	YES	YES
Students' Characteristics	YES	YES

Note: This tables reports events estimates at $j = 0$ and $j = 3$ from equation (1). In column (1), the outcome is an indicator for whether the student took more than 12 exams. In column (2), the outcome is the total number of exams taken. The regression controls for university by fields of study fixed effects and university by year of enrollment fixed effects as well as students' pre-determined characteristics (gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high-school, and an indicator for whether the province of residence is the same as the province of study). Event-study estimates are normalized relative to the cohort of students that enrolled in the year prior to the enactment of the new regime. Pre-reform mean reports the average of a given outcome for the last cohort who studied under the pre-reform regime. Standard errors are clustered at the university level. *** p<0.01, ** p<0.05, * p<0.1

Figure A.2: Sensitivity of the results on the number of exams according to the honest bounds of Rambachan and Roth (2023)



Note: This figure reports the confidence sets described in Rambachan and Roth (2023) for the average of all post-reform coefficients on the outcomes described in Figure 1 when we allow the slope of the pre-trend coefficients to change by no more than M—reported on the x-axis—across consecutive cohorts. Values of $M = 0$ correspond to cases where differences between treated and control are exactly linear.

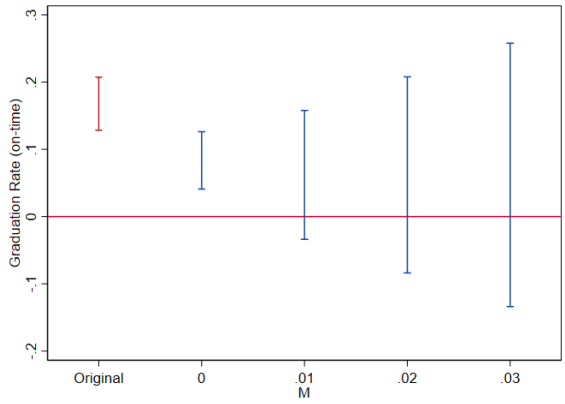
Table A.4: Reform Effect on Graduation Rate

	(1) Fraction of Students Graduating in Two Years or Less	(2) Fraction of Students Graduating in Three Years or Less	(3) Graduation Rate
First cohort enrolled in the reform ($j = 0$)	0.042***	0.028***	0.011*
	(0.010)	(0.008)	(0.006)
Last cohort enrolled in the reform ($j = 3$)	0.127***	0.063***	0.016
	(0.033)	(0.028)	(0.019)
Observations	3,044	3,080	3,084
Pre-reform Mean	0.39	0.63	0.77
University by Major FEs	YES	YES	YES
University by Cohorts of Entry FEs	YES	YES	YES

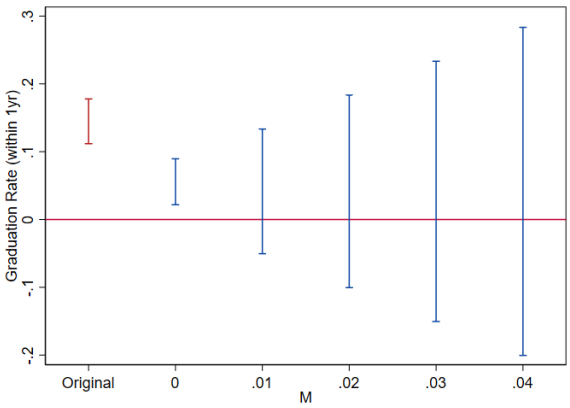
Note: This table reports event estimates at $j = 0$ and $j = 3$ from the event study depicted in Figure 2. Majors are groups of fields of study defined by Italian National Statistic Institute (ISTAT) and include: Scientific, Chemistry-Pharmaceutical, Geo-Biological, Medical, Engineering, Architecture, Agricultural-Veterinary, Economics-Statistics, Political-Social, Law, Literary, Education, Psychological, and Physical Education. In column (1), the outcome is the fraction of students graduating on-time, i.e. the fraction of students that obtained their degree within the nominal duration of an LM degree (which is two years). In column (2), the outcome is the fraction of students that graduated in three years. In panel (3), the outcome is the fraction of students graduating. For all these outcomes, the denominator is represented by the number of students *enrolling* in a given year × major × university. Estimates are weighted by the number of enrolled students. Event-study estimates are normalized relative to the cohort of students that enrolled in the year prior to the enactment of the new regime. Pre-reform mean reports the average of a given outcome for the last cohort who studied under the pre-reform regime. Standard errors are clustered at the university level. *** p<0.01, ** p<0.05, * p<0.1

Figure A.3: Sensitivity of the results on the graduation rate according to the honest bounds of Rambachan and Roth (2023)

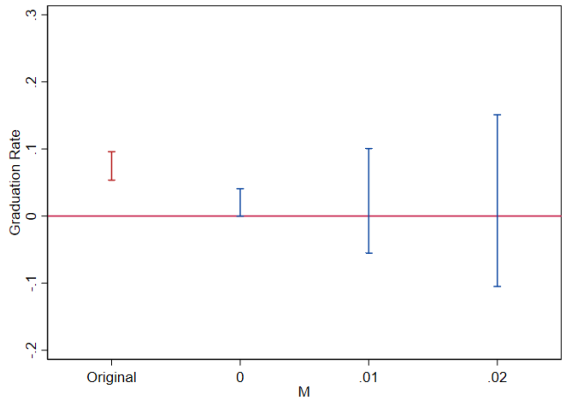
(a) Fraction of Students Graduating in Two Years or Less (On-Time Graduation)



(b) Fraction of Students Graduating in Three Years or Less



(c) Graduation Rate



Note: This figure reports the confidence sets described in Rambachan and Roth (2023) for the average of all post-reform coefficients on the outcomes described in Figure 2 when we allow the slope of the pre-trend coefficients to change by no more than M—reported on the x-axis—across consecutive cohorts. Values of $M = 0$ correspond to cases where differences between treated and control are exactly linear.

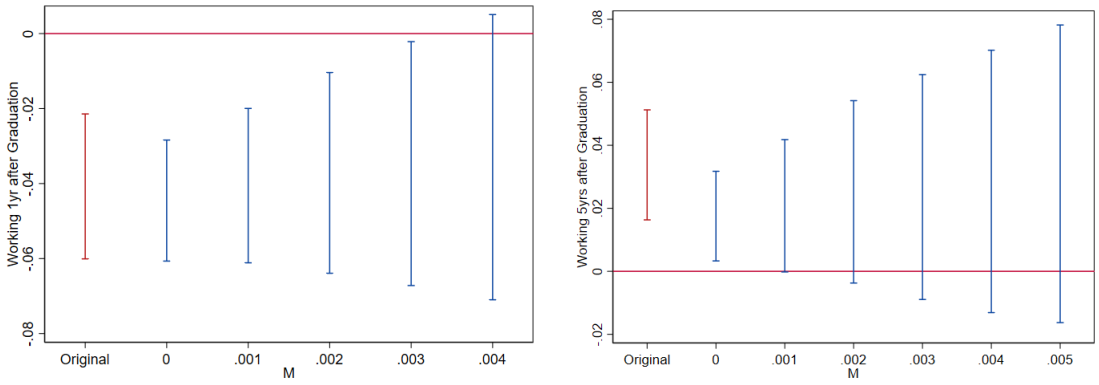
Table A.5: Labor Market Outcomes

	Working		Earnings	
	(1)	(2)	(3)	(4)
	1yr after	5yrs after	1yr after	5yrs after
First cohort enrolled in the reform ($j = 0$)	-0.017***	0.011**	-14.735	24.620**
	(0.006)	(0.004)	(9.454)	(11.054)
Last cohort enrolled in the reform ($j = 3$)	-0.068***	0.055***	-50.265	102.720***
	(0.017)	(0.017)	(34.234)	(28.032)
Observations	221,336	221,336	182,410	204,026
Pre-reform Mean	0.72	0.86	668.4	1155.8
University by Fields of Study FEs	YES	YES	YES	YES
University by Cohorts of Entry FEs	YES	YES	YES	YES
Students' Characteristics	YES	YES	YES	YES

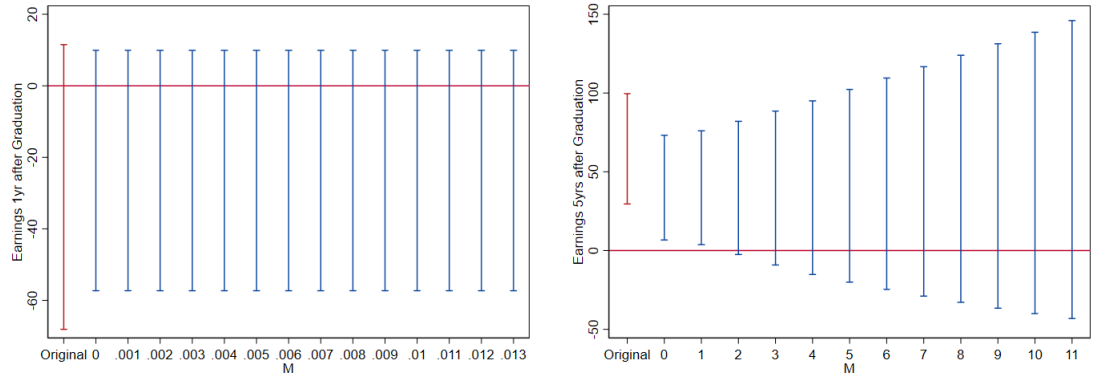
Note: This tables reports events estimates at $j = 0$ and $j = 3$ from equation (1). In columns (1) and (2), the outcome is an indicator equal to 1 if the worker has a job one year after graduation (column 1) or 5 years after graduation. This indicator is equal to zero if the student remains in school (e.g., the student is enrolled in a master's program or a PhD). Columns (3) and (4) are similar but look at earnings (with earnings set equal to zero for students not working, and missing when a student with a job decides to not report their wage). The regression controls for university by fields of study fixed effects and university by year of enrollment fixed effects as well as students' pre-determined characteristics (gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high-school, and an indicator for whether the province of residence is the same as the province of study). Event-study estimates are normalized relative to the cohort of students that enrolled in the year prior to the enactment of the new regime. Standard errors are clustered at the university level. *** p<0.01, ** p<0.05, * p<0.1

Figure A.4: Sensitivity of the results on the labor market outcomes according to the honest bounds of Rambachan and Roth (2023)

(a) Probability of Working



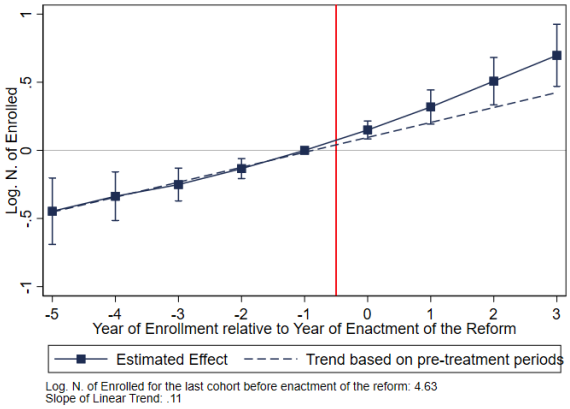
(b) Earnings



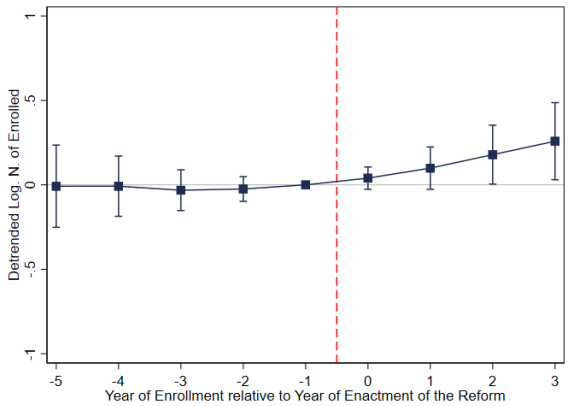
Note: This figure reports the confidence sets described in Rambachan and Roth (2023) for the average of all post-reform coefficients on the outcomes described in Figure 3 when we allow the slope of the pre-trend coefficients to change by no more than M—reported on the x-axis—across consecutive cohorts. Values of $M = 0$ correspond to cases where differences between treated and control are exactly linear. Labor market outcomes one year post-graduation are reported on the left-graphs, while those five years from graduation are reported on the right graphs.

Figure A.5: Event Study on Number of Enrolled

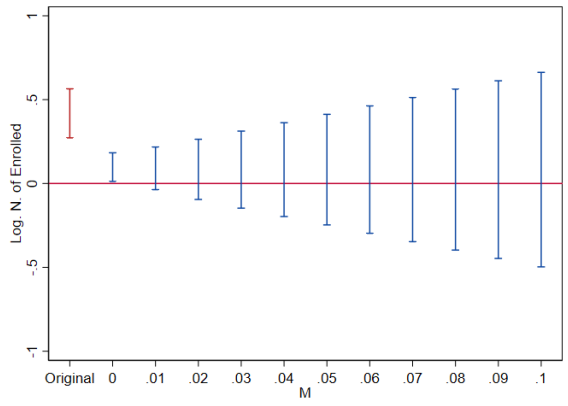
(a) N. of Enrolled



(b) Detrended N. of Enrolled

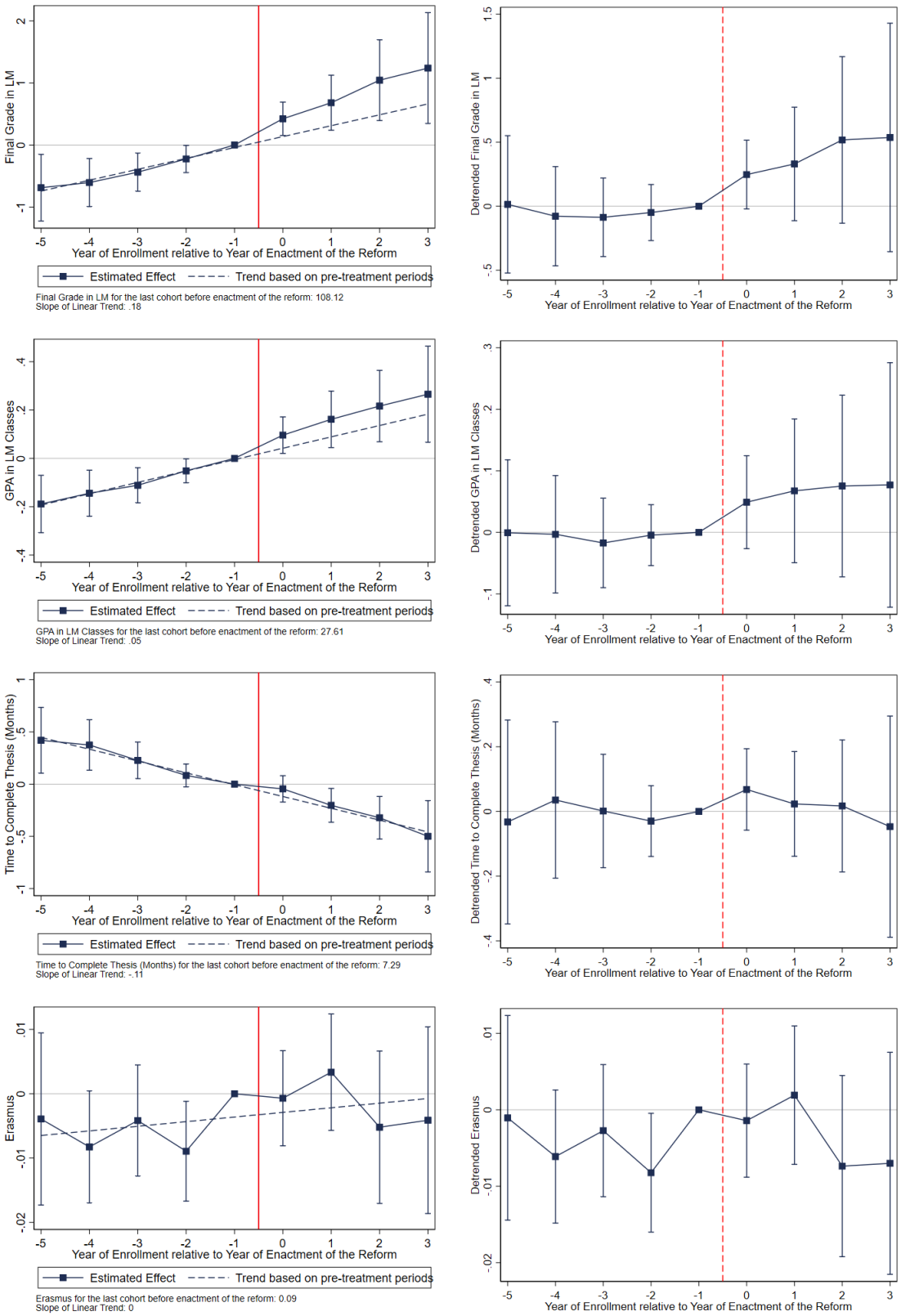


(c) Honest Bound on the N. of Enrolled



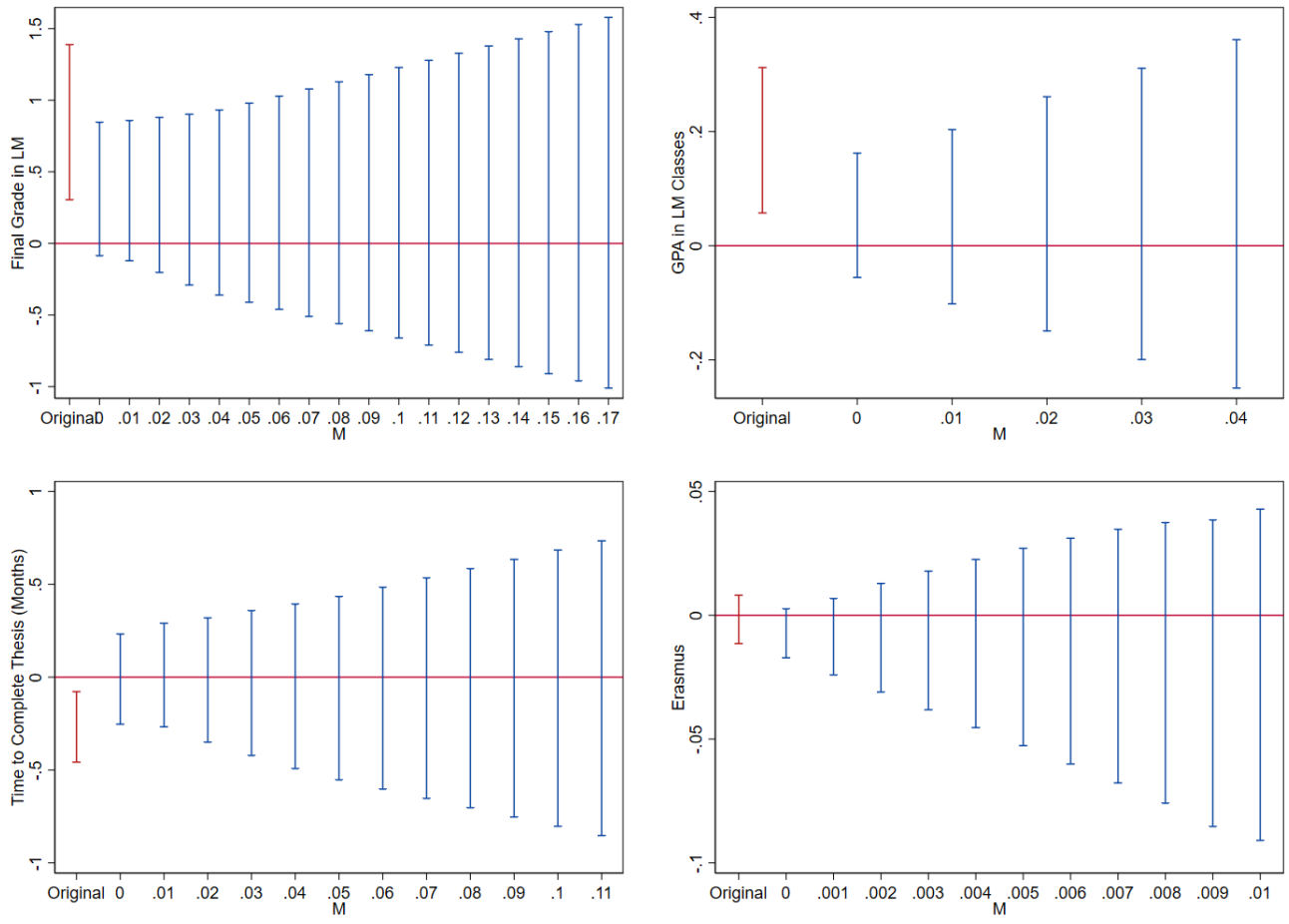
Note: This figure reports estimates from a version of equation (1) collapsed at the university × major × year of enrollment that controls for university by major and university by year of enrollment fixed effects. The outcome variable is the logarithm of the number of enrolled students. Majors are groups of fields of study defined by the Italian National Statistic Institute (ISTAT) and include: Scientific, Chemistry-Pharmaceutical, Geo-Biological, Medical, Engineering, Architecture, Agricultural-Veterinary, Economics-Statistics, Political-Social, Law, Literary, Education, Psychological, and Physical Education. In panel (a), we also report the linear trend estimated using pre-reform event-study coefficients only extrapolated to post-reform cohorts (dashed line). In panel (b), we report the deviations from the event-study coefficients to this linear time trend. Estimates are weighted by the number of enrolled students. We omit the coefficient for those students who have enrolled in the year prior to the enactment of the new regime. The straight line indicates the first entry cohort that studies under the new reform. Below the graph of panel (a), we report the slope of the pre-event event-study coefficients as well as the average of the outcome variable for the last cohort of students who enrolled in the pre-reform regime. 95% confidence intervals are obtained after clustering the standard errors at the university level. Panel (c) reports the confidence sets described in Rambachan and Roth (2023) for the average of all post-reform coefficients when we allow the slope of the pre-trend coefficients to change by no more than M—reported on the x-axis—across consecutive cohorts. Values of $M = 0$ correspond to cases where differences between treated and control are exactly linear.

Figure A.6: Quality of Human Capital



Note: This figure reports estimates from equation (1). Outcomes measure the quality of human capital accumulated by students, such as the final LM grade that ranges from 66 to 110, the grade point average (GPA) obtained in the exams of the LM and ranging from 18 to 30, the time to complete the final thesis, and the likelihood of studying abroad (*Erasmus*). On the left, we report the linear trend estimated using pre-reform event-study coefficients only extrapolated to post-reform cohorts. On the right, we report the deviations from the event-study coefficients to this linear time trend. The regression controls for university by field of study fixed effects and university by year of enrollment fixed effects as well as students' pre-determined characteristics (gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high-school, and an indicator for whether the province of residence is the same as the province of study). Event-study estimates are normalized relative to the cohort of students that enrolled in the year prior to the enactment of the new regime. The straight line indicates the first entry cohort that studies under the new reform. Below each graph on the left, we report the slope of the pre-event event-study coefficients as well as the average of the outcome variable for the last cohort of students who enrolled in the pre-reform regime. 95% confidence intervals are obtained after clustering the standard errors at the university level.

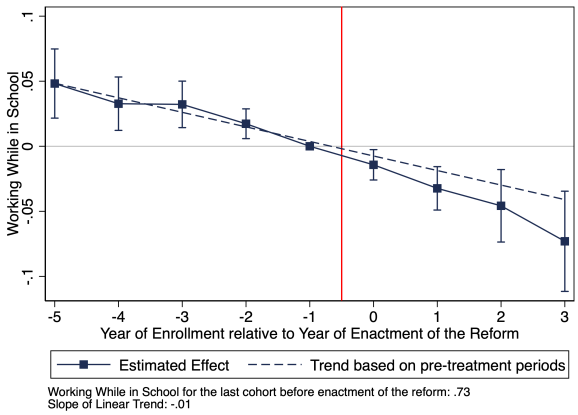
Figure A.7: Sensitivity of the results on the quality of human capital according to the honest bounds of Rambachan and Roth (2023)



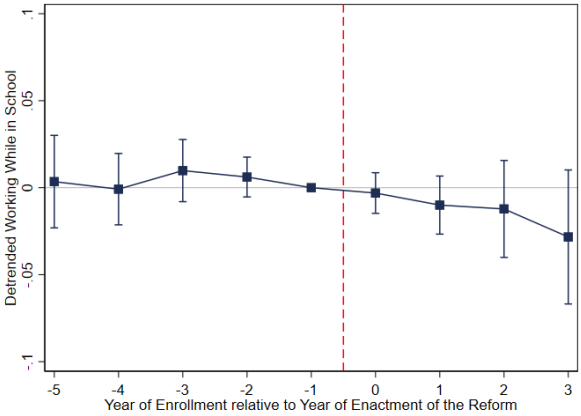
Note: This figure reports the confidence sets described in Rambachan and Roth (2023) for the average of all post-reform coefficients on the outcomes described in Figure A.6 when we allow the slope of the pre-trend coefficients to change by no more than M—reported on the x-axis—across consecutive cohorts. Values of $M = 0$ correspond to cases where differences between treated and control is exactly linear. Labor market outcomes one year post graduation are reported on the left-graphs, while those at five years from graduation are reported on the right-graphs.

Figure A.8: Effect on the Probability to Work While Still Enrolled in School

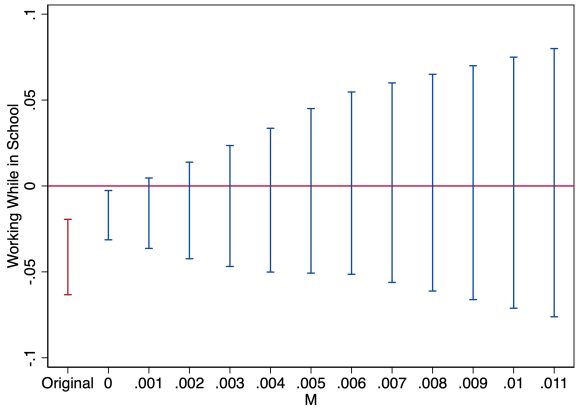
(a) Work While in School



(b) Detrended Work While in School



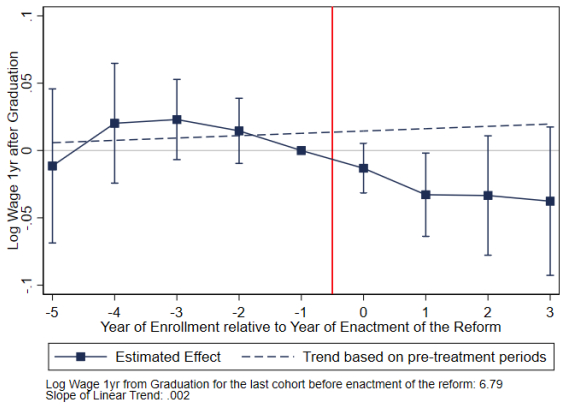
(c) Honest Bound on Work While in School



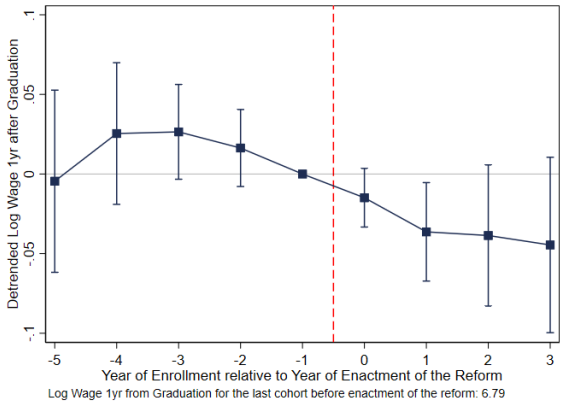
Note: This figure reports estimates from equation (1). The outcome is an indicator of whether students worked while still enrolled in school (e.g., having an internship while still enrolled in the LM degree). In panel (a), we also report the linear trend estimated using pre-reform event-study coefficients only extrapolated to post-reform cohorts (dashed line). In panel (b), we report the deviations from the event-study coefficients to this linear time trend. The regression controls for university by field of study fixed effects and university by year of enrollment fixed effects as well as students' pre-determined characteristics (gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high-school, and an indicator for whether the province of residence is the same as the province of study). Event-study estimates are normalized relative to the cohort of students that enrolled in the year prior to the enactment of the new regime. The straight line indicates the first entry cohort that studies under the new reform. Below the graph of panel (a), we report the slope of the pre-event event-study coefficients as well as the average of the outcome variable for the last cohort of students who enrolled in the pre-reform regime. 95% confidence intervals are obtained after clustering the standard errors at the university level. Panel (c) reports the confidence sets described in Rambachan and Roth (2023) for the average of all post-reform coefficients when we allow the slope of the pre-trend coefficients to change by no more than M—reported on the x-axis—across consecutive cohorts. Values of $M = 0$ correspond to cases where differences between treated and control are exactly linear.

Figure A.9: Effect on the Log. Wages One Year After Graduation

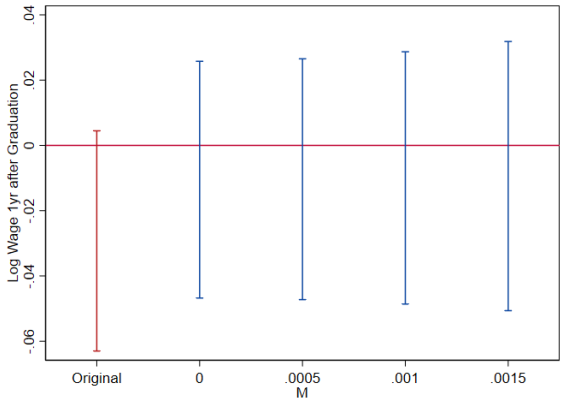
(a) Log. Wage



(b) Detrended Log. Wage



(c) Honest Bound on Log. Wage



Note: This figure reports estimates from equation (1). The outcome is the student's log monthly wage one year after graduation. In panel (a), we also report the linear trend estimated using pre-reform event-study coefficients only extrapolated to post-reform cohorts (dashed line). In panel (b), we report the deviations from the event-study coefficients to this linear time trend. The regression controls for university by field of study fixed effects and university by year of enrollment fixed effects as well as students' pre-determined characteristics (gender, age at entry, foreign, parent's college, a cubic in high school final grade, dummies for type of high-school, and an indicator for whether the province of residence is the same as the province of study). Event-study estimates are normalized relative to the cohort of students that enrolled in the year prior to the enactment of the new regime. The straight line indicates the first entry cohort that studies under the new reform. Below the graph of panel (a), we report the slope of the pre-event event-study coefficients as well as the average of the outcome variable for the last cohort of students who enrolled in the pre-reform regime. 95% confidence intervals are obtained after clustering the standard errors at the university level. Panel (c) reports the confidence sets described in Rambachan and Roth (2023) for the average of all post-reform coefficients on the number of enrolled students when we allow the slope of the pre-trend coefficients to change by no more than M—reported on the x-axis—across consecutive cohorts. Values of $M = 0$ correspond to cases where differences between treated and control are exactly linear.