The University of Chicago

Public Spending and Education: Understanding Italy's Lag in Tertiary Education Attainment

An Analysis of the Gelmini reform's Impact on Tertiary Educational Outcomes in Italy

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Abstract

This thesis examines whether limited public spending on higher education contributes to Italy's low levels of tertiary education attainment. I use the 2010 Gelmini reform—which introduced severe funding cuts and a performance-based system for allocating university funding—as an exogenous shock to government spending and assess its impact on tertiary attainment rates. The analysis applies causal inference methods, including difference-in-differences and synthetic controls, and considers the reform's impact across two dimensions: in Italy relative to other European countries (cross-country) and across different Italian universities (within-country). While the cross-country analysis does not yield statistically significant effects, the within-country analysis shows that lower-ranked universities, which were more exposed to funding cuts, experienced significantly larger enrollment declines after the reform. These findings suggest that public spending is critical to tertiary education outcomes and that performance-based funding systems may deepen inequalities among institutions.

Keywords: Italy, tertiary education, public spending, Gelmini reform, tertiary attainment, tertiary enrollment, difference-in-differences, synthetic control

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Contents

1 Introduction

Despite having one of the largest economies in Europe and being home to the oldest university in continuous operation, Italy consistently ranks among the countries with the lowest levels of tertiary education attainment in Europe.[1] In 2023, less than 35% of Italians aged 25-34 had a university degree, placing Italy near the bottom of the EU rankings—just ahead of Romania and Hungary (Eurostat 2024b). In contrast, the EU average stands at 43%, and 13 member states have already surpassed the EU's 2030 target for tertiary attainment. These include Ireland (63% of total population aged 25-34), Cyprus (62%), Luxembourg (60%), Lithuania (57%), the Netherlands (55%), Sweden (54%), Spain and France (both 52%), Belgium (50%), Denmark (49%), Malta and Poland (both 46%) and Latvia (45%) (Eurostat 2024a). Understanding what drives greater participation in tertiary education is extremely important, as tertiary education plays a crucial role in promoting social mobility and economic growth (Oketch, McCowan, and Schendel 2014).

At a micro level, tertiary education helps individuals access better job opportunities and achieve higher standards of living. As a matter of fact, university graduates earn on average higher wages than those with only a high school diploma. This in turn, can help break cycles of poverty and reduce economic disparities. At a macro level, higher education is a key driver of economic growth and innovation. Countries with higher tertiary education attainment rates tend to have stronger economies, higher levels of technological innovation, and greater productivity (Li, Xue, Wei, et al. 2024). Given Italy's stagnant economic growth and persistent socioeconomic inequalities, understanding what is contributing to its significant lag in tertiary education attainment is essential for shaping policies that foster long-term social and economic prosperity. What motivates my thesis is therefore achieving a better understanding of what may explain Italy's low tertiary education attainment levels.

However, a complex social phenomenon, such as the decision to enroll and complete a university degree, does not have a single explanation. There are several factors that may explain why so many Italians do not attend university, which I have categorized as being either: 1) supply-side issues, 2) demand-side issues or 3) constraint-to-demand problems. Supply-side issues in this context refer to factors that affect the availability and quality of education. Some examples of supply-side constraints include a small number of universities in a given territory, limited university capacity, and poor quality and organizational structure of the education system. Demand side issues refer to factors that affect the students' willingness and motivation to pursue higher education even when education is in fact available. For instance, if there are low returns to education, high opportunity costs of attending university, or the labor market doesn't demand high-skilled labor, students may prefer to enter the job market right after high-school, leading to low tertiary education

1. Tertiary education refers to any kind of education or training obtained after High School, including Undergraduate, Graduate, PhD, and Vocational Training

attainment. Finally, the reason for Italy's low tertiary education attainment may be explained by constraint-to-demand problems. It is possible that there is demand for higher education, but there are factors that prevent students from pursuing it. Some of these factors could be high tuition fees, lack of financial aid, strict admission criteria, and geographic barriers.

In this research I will focus on constraint-to-demand issues, looking specifically at the relationship between public spending on higher education and tertiary education attainment. Reduced spending on education can create constraints to demand if it leads universities to increase tuition fees, lower financial aid, or reduce the number of courses offered. Italy has historically spent substantially less on tertiary education than its peer countries. In 2021, Italy spent €4,000 less per student on higher education than the European average, placing it among the EU countries with the lowest investment in tertiary education (Macchi 2024). Moreover, in 2023, Italy spent 0.4% of its GDP on tertiary education, half as much as the EU average expenditure of 0.8% (Eurostat 2025). Assuming that there exists at least a correlation between public expenditure on education and education attainment rates, it is plausible that Italy's low levels of tertiary education attainment are at least partially attributable to the country's low public investment in education. This leads to my research question: *to what extent does low government expenditure on higher education explain Italy's low levels of tertiary education attainment?*

To answer this question, I use the Gelmini reform (Law 240/2010) as an exogenous shock to public funding to universities. Implemented in 2010, the reform introduced sweeping austerity measures to the Italian higher education system, restructuring university governance, creating a performance-based funding system and, most importantly, cutting public expenditure to higher education by over €1 billion over three years. I chose to focus on the Gelmini reform, because it provides a unique opportunity to analyze the causal impact of reduced public funding on tertiary education outcomes.

My analysis will unfold in two dimensions. The first is a cross-country analysis, where I examine how Italy's tertiary enrollment rates changed relative to other European countries after the Gelmini reform was implemented. This allows me to assess whether the reform had a significant causal effect on Italy's educational outcomes and, in turn, whether limited public investment may help explain Italy's lag in tertiary education attainment relative to its European counterparts. My hypothesis is that the Gelmini reform negatively impacted university enrollment and attainment in Italy by significantly reducing public funding to higher education. The second dimension focuses on within-country variation in tertiary educational outcomes across different Italian universities. By introducing a performance-based system for the allocation of public funding to higher education institutions, the reform led to an uneven distribution of funding across universities, favoring institutions that met certain quality standards while penalizing those that did not. This likely deepened existing disparities among universities. I therefore hypothesize that the reform had a heterogeneous

effect across institutions, with universities that experienced larger funding cuts also seeing greater declines in enrollment and attainment. Support for this hypothesis would also underscore the relationship between public spending and tertiary education attainment.

This thesis will unfold as follows. In the next section, I review the existing literature on the relationship between public spending on education and educational outcomes. In section three I provide some background on the Gelmini reform, including the political and economic context of its implementation, the key changes it introduced, and their implications for the Italian higher education system. In section four I evaluate the existing literature on the Gelmini reform and its impact on Italian education. In section five I describe the data sources and the methodologies I used in this study. In section six, I present the empirical results of my analysis. Finally, I conclude with a discussion and interpretation of the findings and offer some potential avenues for further research.

2 Public Spending and Education: a Review of the Literature

Does increased public expenditure on education lead to higher attainment levels and better educational outcomes? The literature on American higher education has shown a clear positive relationship between government expenditure on education and college graduation rates (Kelchen 2024; Chen 2012; Pike and Robbins 2020; Webber and Ehrenberg 2010). For example, state expenditure on higher education is negatively associated with drop-out behavior (Chen 2012), and reduced spending on education leads to higher tuition fees for students (Webber 2017). This results in a positive relationship between state funding and enrollment and completion rates.

The European literature on public spending and higher educational outcomes is less straightforward, but it still suggests that public spending may be an important factor in determining student's achievements and graduation rates (Agasisti 2008; Sibiano and Agasisti 2012; García-Estevez and Duch-Brown 2014; Batare 2012). Agasisti (2008), for example, conducts an efficiency analysis of higher education systems across European countries and finds that higher public investment in education generally correlates with better educational outcomes, but the way funding is allocated matters more than the total amount spent. For instance, countries that directly fund universities tend to perform better than those that rely on indirect subsidies to students. Generally speaking, however, he shows that countries that spend more on education, such as Nordic nations, achieve better educational outcomes. García-Estevez and Duch-Brown (2014) explored the relationship between university characteristics and graduation rates in Spain. They used data from the entire Spanish public university system between 1998 and 2008 and found that higher education expenditure, financial aid, and lower student-to-teacher ratios all significantly influence graduation rates.

At the same time, it is unclear whether public spending is the most significant factor in determining academic achievements. Sibiano and Agasisti (2012) measured how spending heterogeneity across Italian regions impacts efficiency and performance in lower secondary schools. They find that, even after controlling for public spending across regions, students in Northern Italy outperform students in the South in terms of educational outcomes. They suggest that socioeconomic differences between North and South explain most of the gap in students' performances. This finding is supported by the literature on inequality of opportunity and education, which highlights how students' socioeconomic background is the most significant determinant of academic performance (Delaney, Harmon, and Redmond 2011; Palmisano, Biagi, and Peragine 2022; Di Bartolomeo 2011; Contini, Cugnata, and Scagni 2018).

My investigation contributes to the literature on public spending and education in various ways. First, my paper can add evidence to either support or reject the claim that government spending is positively associated with better tertiary education outcomes. More specifically, my research focuses on enrollment and attainment rates, rather than efficiency or students' performances, as they represent the preliminary step in fostering a highly educated society. By using the Gelmini reform I can causally determine how significant reductions in public funding impact enrollment and attainment rates. This will contribute meaningfully to the literature, which often focuses on general correlations between spending levels and educational outcomes, rather than causality. Second, unlike most articles on this topic, I examine the effects of spending cuts on university enrollment and attainment across two dimensions: 1) between Italy and other European countries, and 2) across different universities in Italy. Both dimensions can help determine whether low investment in higher education helps explain Italy's low tertiary attainment rates. By comparing Italy's enrollment rates before and after the Gelmini reform to those of similar countries that did not undergo comparable spending cuts, I can isolate the effect of reduced higher education spending on tertiary education attainment at the national level. On the other hand, by comparing universities that experienced high cuts in public spending to those that experienced low cuts in spending, I can explore how spending cuts affected enrollment and attainment rates at the institutional level. By combining these dimensions in a single paper, this research provides a comprehensive evaluation of how austerity-driven reforms influence higher education outcomes, contributing valuable insights to the broader debate on public investment in education and its consequences on educational outcomes.

3 The Gelmini reform and the Historical Context

The Gelmini reform (Law 240/2010) was implemented in 2010 under the leadership of Mariastella Gelmini, the Italian Minister of Education between 2008 and 2011. The reform introduced significant structural

changes to Italy's tertiary education system. Framed as a measure to streamline university governance, increase efficiency, and promote meritocracy, the reform was characterized by severe funding cuts, which had long-lasting implications for university operations, faculty hiring, student access, and overall educational quality. To fully understand the Gelmini reform, it is crucial to consider it within the broader economic and political context of the 2000s.

In 1999, the European Union launched the Bologna Process—a series of agreements aimed at standardizing higher education systems among member states. In the following year, Italy replaced the traditional single-cycle degree that lasted between 4-6 years, with a 3-year Bachelor degree, followed by a 2-year Master's degree, the so-called 3+2 system (Chies, Graziosi, and Pauli 2018). In addition to making degrees more recognizable across Europe and increasing student mobility, the reform was also aimed at increasing students' performance and reducing university drop-out rates by offering an exit point after three years with a recognized qualification. At the time of its implementation, 60% of students failed to complete their studies and only 10% completed their studies within the official time span (Hunter 2015). In the years following the Bologna reform, Italy registered an increase in enrollment and graduation rates, which are at least partially attributable to the new system (Chies, Graziosi, and Pauli 2018). This "expansive" phase, which lasted until 2007, was characterized by a strengthening of university autonomy, a significant increase in financial and human resources allocated to universities, and a substantial expansion of educational offerings (Stella 2017).

The "depressive" phase of the higher education system in Italy began after 2008 (Stella 2017). At the onset of the financial crisis, Italy was facing mounting public debt and severe fiscal constraints. The newly-elected center-right government led by Silvio Berlusconi responded by introducing a series of reforms aimed at reducing government expenditures across a variety of public sectors. The higher education system became a primary target for spending cuts. In August 2008, the government passed the law, DL 133/2008, which included a plan to cut the budget of the Ordinary Financing Fund (Fondo di Finanziamento Ordinario, or FFO) for universities. Then, in 2010, the Gelmini reform gave effect to and expanded on law 133/2008, introducing a more systematic plan to cut government spending and transition to a "meritocratic", performance-based university model. This approach prioritized funding for a select group of high-performing institutions, while significantly reducing financial support for universities that failed to meet the reform's newly established evaluation criteria, effectively marginalizing lower-ranked institutions while creating a small group of elite universities (Capano 2011).

The most significant changes introduced by the Gelmini reform are (Parlamento Italiano 2010):

1. The introduction of an accreditation system for university campuses and degree programs, based on specific indicators (defined in advance by the National Agency for the Evaluation of Universities and

Research – ANVUR) to verify whether institutions meet appropriate educational, structural, organizational, faculty qualification, research activity, and financial sustainability requirements.

2. The implementation of a periodic evaluation system, established by ANVUR using predefined criteria and indicators, to assess the efficiency and outcomes of teaching and research activities at universities and their internal departments.

3. The enhancement of self-assessment mechanisms within universities to evaluate the quality and effectiveness of their activities, including through internal evaluation units and joint faculty-student committees.

4. The application of performance-based funding mechanisms, linking the distribution of public resources to the teaching and research results achieved by universities.

In this paper, I am primarily concerned with the fourth point, namely the change in public funding to universities based on new standards of teaching and quality of research. Between 2009 and 2015, public spending on tertiary education as a percentage of GDP went down by 13%.[2] The contraction of public investment in universities led to a reduction in the total number of professors by 8.2% between 2009 and 2019 (Carbone 2021). This, in turn, led to an increase in the student-to-teacher ratio, from 27 students per faculty member in 2008 to 31.5 in 2017 (Viesti 2024). Moreover, between 2008 and 2018, the Ordinary Financing Fund for universities decreased by 4% in nominal terms (Viesti 2024). The impact of this policy on Italian universities has been unequal, with institutions in the peripheral North and South-Central regions being the most disadvantaged (Viesti 2024). This is because universities in these areas were already underperforming according to the evaluation criteria introduced by the Gelmini reform, resulting in a disproportionate reduction in funding. Additionally, cuts to public spending forced universities to raise tuition fees, which negatively impacted students living in regions where average incomes tend to be lower. Between 2008 and 2015, tuition fees increased by 17.39% in total across the country, with a 17.27% increase in the North, a 8.93% increase in the Center, and a staggering 26,61% increase in the South (UDU - Unione degli Universitari 2018). The South, Italy's most economically disadvantaged region, saw the highest increase in tuition fees, as well as the highest reduction in FFO, which went down by over 13% in that same period. This exacerbated the already existing socioeconomic disparities between the North and the South (Viesti 2024).

2. I calculated this using the dataset on government spending on tertiary education as a % of GDP from Eurostat

4 The Gelmini reform: a Review of the Literature

Studies evaluating the consequences of the Gelmini reform, collectively suggest that the reform compromised the quality of the education system and exacerbated existing inequalities across Italian regions, by reducing public expenditure to higher education, freezing new faculty hires, and introducing a new performance-based system for the allocation of resources (Gasperoni 2011; Capano 2011; Donina, Meoli, and Paleari 2015; Carbone 2021; Viesti 2024). Some studies have also documented a substantial decline in university enrollment rates following the reform, with the sharpest drops occurring in Southern Italy (Carbone 2021; Viesti 2019, 2024). However, these analyses are largely descriptive: they interpret trends in raw data without employing causal inference methods, leaving open the question of whether the observed declines in enrollment can be directly attributed to the reform itself. There are only a couple of studies that seek to determine the causal impact of the Gelmini reform on educational outcomes, but they focus on the secondary education system rather than on higher education.

Antonello (2021) uses a synthetic control method (SCM) to examine the Gelmini reform's impact on students' performance, as measured by PISA test scores. He finds no significant effects on reading scores and large positive effects on mathematics performance, possibly overestimated by the concurrent introduction of standardized testing (Invalsi). He concludes that the Gelmini reform did not negatively impact Italian students' achievements in international tests. Similarly, Jahanshahi and Naghavi (2017) estimate the causal effect of the Gelmini reform on four academic performance gaps relating to immigration status, gender, parental status, and parental education. They use a difference-in-differences (DiD) strategy and find that the reform had a statistically and economically significant effect on the immigrant-native gap. Particularly they find that students with an immigration background were the main losers from the Gelmini reform.

Existing causal studies on the Gelmini reform have focused primarily on its impact on secondary school students' performance and academic outcomes, with little attention given to its effects on higher education. To date, no research has causally assessed how the reform influenced Italy's university system. The limited literature examining the reform's impact on universities remains largely descriptive, relying on simple trend analyses rather than causal identification strategies. This thesis seeks to fill this gap by estimating the causal effect of the Gelmini reform's spending cuts on tertiary education attainment and enrollment, using both a difference-in-differences approach and a synthetic control method (SCM).

5 Data and Methodology

My analysis is organized into four main parts: 1) a simple cross-sectional regression evaluating the correlation between public spending on tertiary education and tertiary education attainment, 2) a cross-country difference-in-differences analysis of the impact of the Gelmini reform on tertiary education enrollment, 3) a similar cross-country analysis using a synthetic control method, and 4) a continuous difference-in-differences regression of the heterogeneous impact of public spending cuts across Italian universities. In the following subsections, I describe the data and methods used in each part.

5.1 Cross-Sectional Regression

To lay the groundwork for my analysis, I begin with a cross-sectional regression examining the relationship between public expenditure on higher education and tertiary education attainment across European countries between 2000 and 2020. This preliminary step serves to identify whether a meaningful correlation exists between investment levels and attainment outcomes, helping to contextualize and justify the analysis that follows.

To run this simple cross-sectional regression, I use two datasets from Eurostat—the official statistical office of the European Union. The first dataset, identified by the online code `sdg_04_20`, measures the share of the population aged 25-34 who have successfully completed tertiary education across all European countries (Eurostat 2024d).[3] The second dataset measures public expenditure on education by education level and program orientation as a percentage of GDP and is identified by the code `educ_uoe_fine06` (Eurostat 2024c).

The dependent variable is tertiary education attainment, while the independent variable is government expenditure on higher education as a percentage of GDP, lagged by four years. I use a four-year lag because the effects of public spending on tertiary education attainment are not immediate. Since it typically takes between three and five years for students to complete a university degree, a four-year lag better captures the time needed for changes in funding to influence graduation rates and, ultimately, tertiary education attainment.

The model of the cross-sectional regression is specified as follows:

$$Y_{it} = \alpha + \beta \cdot Education\_Spending\_Lag4_{it} + \epsilon_{it} \tag{1}$$

3. In this dataset, educational attainment refers to ISCED (International Standard Classification of Education) 2011 level 5-8 for data from 2014 onward and to ISCED 1997 level 5–6 for data up to 2013.

Where:

- Y_{it} = tertiary education attainment in country i at time t.
- `Education_Spending_Lag4_it` = public spending on education in country i, lagged by 4 years.
- α = the intercept.
- β = the coefficient of interest.
- ϵ_{it} = the error term.

5.2 Cross-Country Analysis

I evaluate the effect of the Gelmini reform on Italy's tertiary education outcomes relative to other European countries using two different methodological approaches. First, I conduct a difference-in-differences regression, and then I run a synthetic control model. In both cases, I use the dataset "Gross Enrolment Ratio in Tertiary Education", which I downloaded from the website, Our World in Data (Our World in Data 2024). This dataset, which was derived from the UNESCO Institute for Statistics, measures the number of people of any age group who are enrolled in tertiary education expressed as a percentage of the total population of the five-year age group following on from secondary school leaving.[4]

Although my research question is centered around Italy's low levels of tertiary education attainment, I used gross enrollment as the dependent variable in the rest of my analysis because attainment responds with a lag to government expenditure decisions and may be influenced by other factors. Enrollment, by contrast, responds more quickly to shifts in public funding, making it a more suitable short-term indicator for evaluating the immediate impact of the Gelmini reform. While gross enrollment does not directly measure attainment—there are also other factors such as drop-out rates or delayed completion that also influence attainment rates—it remains closely linked to it: higher enrollment levels generally lead to higher attainment rates over time.

Tables 1 and 2 below measure the correlation between gross enrollment and attainment rates. Table 1 measures the relationship between the two across European countries between 2000 and 2021. The regression shows a strong, positive relationship between enrollment and attainment. In particular, for every one percentage point increase in the gross enrollment rate, attainment increases by 0.18 percentage points on average. The coefficient is statistically significant at the 0.05 confidence level. In Italy, the correlation between enrollment and attainment over the same period of time is even stronger. The regression in Table

4. Gross Enrollment Rate can surpass 100% when including students outside the official age due to early or late admission and grade repetition.

2 suggests that, in Italy, a one percentage point increase in enrollment leads to a 0.67 percentage point increase in attainment, and this result is also statistically significant. Given this strong relationship, the gross enrollment rate offers a timely and informative proxy for assessing how policy changes may influence the future evolution of tertiary attainment rates.

Table 1: *
Enrollment and Attainment Relationship (EU)

	(1)
Constant	24.176***
	(1.764)
Tertiary Enrollment Rate (%)	0.184***
	(0.025)
R^2	0.103
Adj. R^2	0.101
Num. obs.	483

Table 2: *
Enrollment and Attainment Relationship (Italy)

	(1)
Constant	−21.742
	(13.373)
Tertiary Enrollment Rate (%)	0.673**
	(0.211)
R^2	0.337
Adj. R^2	0.303
Num. obs.	22

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$. Standard errors in parentheses.

5.2.1 Cross-Country Difference-in-Differences

The cross-country analysis begins with a difference-in-differences (DiD) regression that compares trends in tertiary education enrollment between Italy and a control group of 16 European countries over the five years before and after the 2010 Gelmini reform. The control group is composed of only 16 countries because data on gross enrollment rates was not available for all 27 EU countries between 2004 and 2015.[5] By comparing Italy's post-reform enrollment trends to those of similar countries that did not experience comparable spending cuts, the DiD method helps isolate the causal effect of the policy on Italy's higher education outcomes.

The model is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 \text{Post}_t + \beta_2 \text{Italy}_i + \beta_3 (\text{Post}_t \times \text{Italy}_i) + \epsilon_{it} \tag{2}$$

Where:

- Y_{it} = tertiary education enrollment for country i in year t.
- $\text{Post}_t = 1$ if year t is between 2010 and 2015, 0 if it's between 2004 and 2009.
- $\text{Italy}_i = 1$ if the country is Italy, 0 for other countries.
- $\text{Post}_t \times \text{Italy}_i$ = interaction term capturing the treatment effect.

The coefficient of interest here is β_3, the interaction term between the post-reform dummy and the Italy dummy. β_3 captures the treatment effect of the Gelmini reform on enrollment rates in Italy relative to the

5. The 16 countries are: Belgium, Czechia, Denmark, Estonia, Finland, France, Iceland, Ireland, Lithuania, Norway, Romania, Slovenia, Spain, Sweden, Switzerland, United Kingdom

control group. Standard errors are clustered at the country level to account for possible correlation of errors within countries over time.

5.2.2 Cross-Country Synthetic Control Method

In addition to a DiD, I also conducted a synthetic control method (SCM) to determine the effect of the Gelmini reform on tertiary enrollment rates. The SCM is usually applied in situations where a single unit (e.g., a state or country) receives a treatment (e.g., a policy intervention), and the goal is to estimate what would have happened to this unit in the absence of the intervention. In contrast to a DiD, SCM is designed for cases in which there is a single treated unit (Italy in this case) and multiple units in control (other European countries), and it does not require parallel trends to hold. The SCM constructs a synthetic control group where each unit is assigned a weight based on how closely it resembles the pretreatment trends of the treated group, rather than assuming that all untreated units are equally comparable, as in a DiD

For my synthetic control analysis of the impact of the Gelmini reform on Italy's gross enrollment rates, I used the package `augsynth` in R (Michael 2024). This package estimates treatment effects using augmented synthetic control methods. In this case, the model constructs a synthetic Italy by assigning optimal weights to a combination of European countries that closely match Italy's pre-reform trends. This allows for a credible estimation of the counterfactual—that is, what Italy's tertiary education outcomes would have looked like in the absence of the reform. By comparing the actual outcomes for Italy to those of its synthetic counterpart, the method captures the causal effect of the policy intervention without requiring the parallel trends assumption to hold. The synthetic control estimate of the counterfactual (what Italy's enrollment rate would have been in the absence of the reform) is given by a weighted average of the enrollment rates of the control countries in the pretreatment period (between 2004 and 2009):

$$\hat{Y}_{it}^{SC} = \sum_{j \neq \text{Italy}} w_j Y_{jt} \tag{3}$$

Where w_j are non-negative weights assigned to each control country j, such that $\sum_j w_j = 1$. These weights are selected to minimize the distance between Italy and the synthetic control in the pre-treatment period. The treatment effect is then computed as the difference between the observed outcome and the synthetic control estimate:

$$\hat{\tau}_{it} = Y_{it} - \hat{Y}_{it}^{SC}, \quad \text{for } i = \text{Italy},\ t \geq 2010 \tag{4}$$

5.3 Within-Italy Study: Continuous Difference-in-Differences

This second part of my study seeks to estimate the heterogeneous effect of the Gelmini reform on individual Italian universities. To estimate the causal effect of the policy on university enrollment, I implemented a continuous difference-in-differences (DiD) model with two-way fixed effects using enrollment data on 51 Italian universities between 2004 and 2015 (6 years prior and 6 years after the reform). The university-level enrollment data, known as, *iscritti per ateneo*, is publicly available on the website of the Italian Ministry of University and Research (MIUR 2024b). It provides information on the total number of students enrolled at each Italian university between 2000 and 2023.

The Gelmini reform reduced the overall budget to the higher education system, and introduced a performance-based system for the allocation of the Ordinary Financing Fund (FFO), leading to significant variations in public funding across institutions. The National Agency for the Evaluation of Universities and Research Institutions (ANVUR), established by the Gelmini reform, is the agency responsible for evaluating Italian universities and determining how to allocate funding. Since the ANVUR evaluation of Italian universities for 2010 was not publicly available, I used the 2010 ranking generated by Scimago Institutions Ranking as a proxy for university quality and performance (Scimago Institutions Ranking 2010). I assumed that universities that were more highly ranked by Scimago would also have been ranked highly by ANVUR. I also assumed that universities that were ranked lower experienced greater cuts in funding, as a result of the performance-based funding system introduced by the Gelmini reform, and therefore greater reductions in enrollments compared to institutions that were highly ranked.

The DiD model is specified as follows:

$$\log(Y_{it}) = \beta_0 + \beta_1 \, Post_t + \beta_2 \, Exposure_i + \beta_3 \, (Post_t \times Exposure_i) + \alpha_i + \gamma_t + \epsilon_{it} \tag{5}$$

Where:

- $\log(Y_{it})$ = the natural logarithm of total enrollment at university i in year t.
- $Post_t$ = a dummy variable equal to 1 for years after 2010 and 0 otherwise.
- $Exposure_i$ = the continuous exposure variable based on the Scimago ranking.
- $Post_t \times Exposure_i$ = the interaction term capturing the differential effect of the reform by level of exposure.
- α_i = university fixed effects.

- γ_t = year fixed effects.
- ϵ_{it} = the error term.

The dependent variable is the natural logarithm of total enrollment (log enrollment) for each university-year observation. I used a log-linear model because it allows for interpreting estimated effects as percentage changes and helps correct for the skewed distribution of enrollment data among larger universities.

The key explanatory variables include a post-reform indicator, which equals one for years after 2010 and zero otherwise; a continuous exposure-to-treatment variable based on the Scimago Institutions Ranking; and the interaction between these two variables. The exposure score was calculated by standardizing each university's Scimago rank using the `scale()` function in R. This converts the raw values into z-scores by subtracting the sample mean and dividing by the standard deviation. The score, in turn, indicates how many standard deviations each university's ranking differs from the average. Higher scores correspond to lower-performing universities, which are assumed to be more negatively affected by the Gelmini reform's performance-based funding cuts.

The interaction term (β_3) captures the differential effect of the reform on enrollments. This is the primary coefficient of interest and it indicates whether universities with lower rankings experienced larger changes in enrollment following the reform. A negative and statistically significant coefficient would suggest that worse-ranked universities suffered larger enrollment declines after the introduction of performance-based funding.

I include university fixed effects to control for all time-invariant characteristics specific to each institution and year fixed effects to account for common shocks or trends affecting all universities in a given year. Standard errors are clustered at the university level to allow for arbitrary correlation of errors within institutions over time.

6 Results

6.1 Results from the Cross-Sectional Regression

The simple cross-sectional regression of lagged spending on tertiary education attainment across 30 European countries over the time period between 2000 and 2020, indicates that there is a positive and statistically significant relationship between public spending on tertiary education and tertiary education attainment. Specifically, a one percentage point increase in education spending (four years prior) increases tertiary education attainment by almost 8.4 percentage points. This result is statistically significant at the 0.001 confidence level. While this regression can only establish correlation and not causation, it supports the claim

that government expenditure may have an impact on tertiary attainment rates. Hence, it is plausible that the Gelmini reform, having cut public funding to universities, may be partially responsible for Italy's low tertiary education attainment.

Table 3: Cross-Sectional Regression Results

	(1)
Constant	26.838***
	(1.275)
Education Spending (4-year lag)	8.433***
	(0.940)
R^2	0.160
Adj. R^2	0.158
Num. obs.	423

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$. Robust standard errors clustered by university.

6.2 Results from the Cross-Country DiD

The cross-country DiD regression below (table 4) estimates the impact of the Gelmini reform on the rate of tertiary education enrollment in Italy relative to a control group of 16 European countries.

The key coefficient of interest is the interaction term `Italy:Post_2010`, which captures the differential effect of the reform on Italy compared to the control group after 2010. The estimate is -7.97, and it is statistically significant at the 95% confidence level. This suggests that, after the reform, Italy experienced an almost 8 percentage point decrease in gross enrollment rate relative to the control group. An 8 percentage point decrease from a baseline of 67% in 2009 means that enrollment fell by about 12% relative to the pre-reform level. This finding supports the hypothesis that the Gelmini reform negatively impacted tertiary education enrollment rates in Italy.

Table 4: Cross-Country DiD Results

	(1)
Constant	68.156***
	(3.222)
Italy (Treated)	−1.598
	(3.222)
Post-2010	3.861*
	(1.698)
Italy × Post-2010 (DiD Effect)	−7.972***
	(1.698)
R^2	0.037
Adj. R^2	0.023
DF Resid.	15.000
nobs	204

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$. Standard errors clustered by country.

However, for a DiD regression to yield accurate estimates of the treatment effect (the Gelmini reform in this case) the parallel trends assumption must hold. The parallel trends assumption is a key assumption in DiD models, and it requires that, in the absence of treatment, the treated and control groups would have followed similar trajectories. To test the parallel trends assumption, I first ran a dynamic event study plot—a graphical tool that displays the estimated treatment effects for each period before and after the intervention, relative to a chosen baseline year. Figure 1 presents a dynamic event study plot estimating the effects of the Gelmini reform on tertiary education enrollment rates in Italy relative to a control group of European countries. The x-axis shows years relative to the reform year (2010), and the y-axis reports the estimated effects with 95% confidence intervals. I selected 2009 as the baseline because it immediately precedes the introduction of the Gelmini reform's austerity measures, and therefore serves as a reference point for comparing pre-reform and post-reform enrollment estimates.

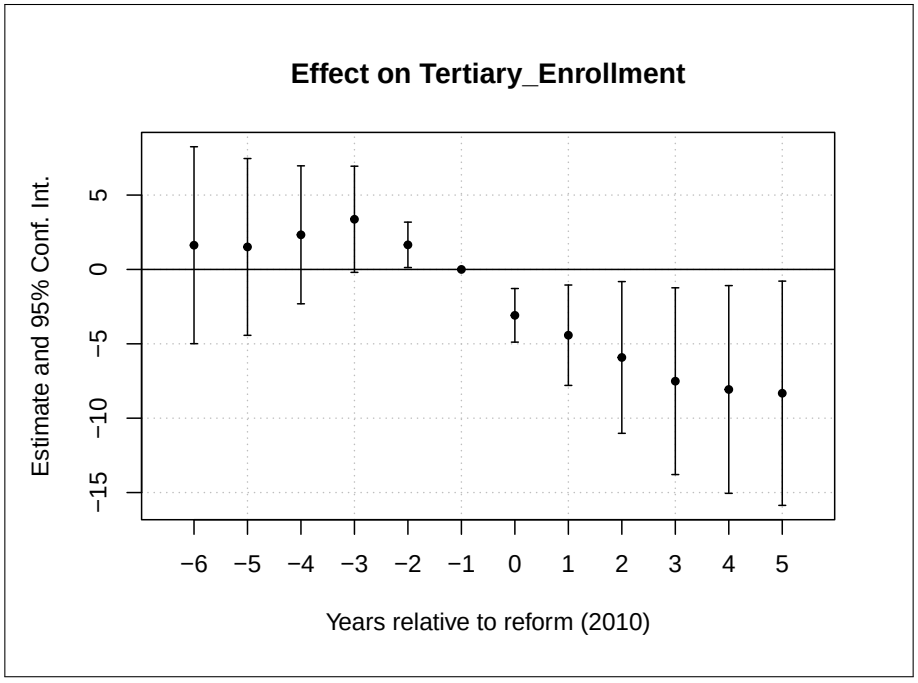

Figure 1: Dynamic event study plot of tertiary education enrollment with baseline year 2009.

In the pre-reform period (years -6 to -1), the point estimates are not statistically different from zero, as demonstrated by the confidence intervals on the pretreatment coefficients mostly overlapping zero. This is generally a good indication of parallel trends. However, the trend of the estimates is not perfectly flat, there is a slight upward trend in enrollment until approximately `year_rel` = -3 (2007), followed by a slight decline leading up to the reform. This raises some concerns about the validity of the parallel trends assumption, which is critical for identifying causal effects in a difference-in-differences framework.

Starting from the reform year (0) and continuing through year 5, the estimates become negative, indi-

cating a decline in enrollment rates in Italy compared to the control group. The confidence intervals remain below zero in the early post-reform years, suggesting that the reform had a statistically meaningful negative impact on tertiary enrollment. However, the confidence intervals become larger and larger as we move away from the year in which the reform was implemented, indicating increasing uncertainty in the estimates.

As a robustness check, I also plotted tertiary education enrollment trends over time for both the treated and control groups during the 2004–2015 period. Figure 2 reveals a much clearer picture of parallel trends between Italy and the control group. It shows a steady upward trajectory in Italy's enrollment rate until 2007, followed by a sharp decline that persists through 2013. The trends in enrollment rates between Italy and the control group were parallel up until 2007, but took opposite turns since then. By the time the Gelmini reform was implemented in 2010, the trend between treated and control was already diverging. This violates the parallel trends assumption required for the DiD, leading me to reject the results from the DiD.

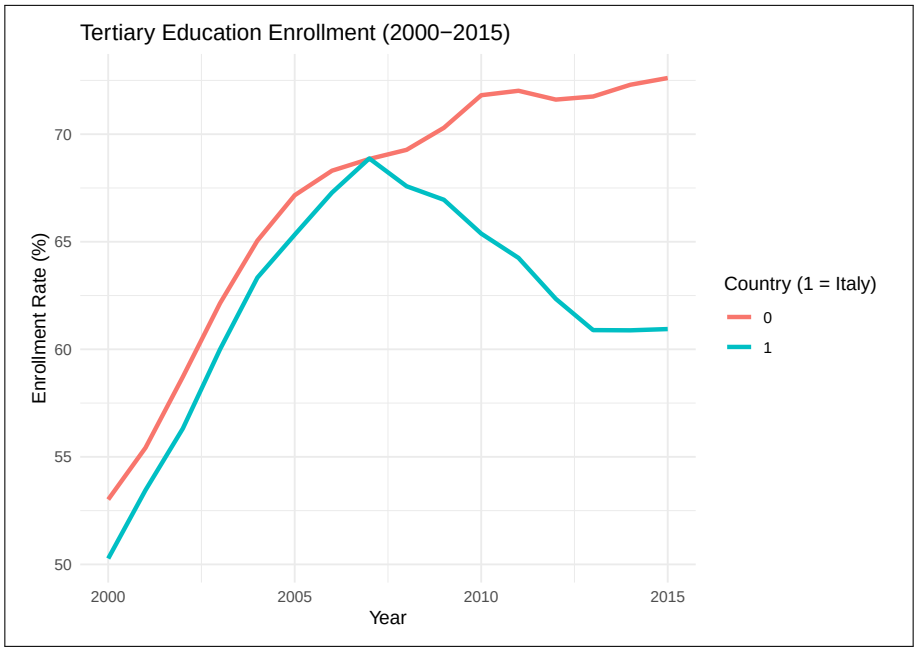

Figure 2: Tertiary education enrollment trends in Italy and control countries.

6.3 Results from the Synthetic Control Method

The results from the synthetic control method indicate that, on average, the Gelmini reform led to an estimated 11 percentage point decrease in tertiary education enrollment in Italy relative to its synthetic counterfactual. However, this result is not statistically significant, as reflected by a p-value of 0.53, suggesting that we cannot reject the null hypothesis of no effect. The L2 imbalance score of 1.285 shows a reasonably good pre-treatment fit between Italy and the weighted average of control countries, and the 80.4% improve-

ment from uniform weights indicates that the synthetic control model substantially improves precision upon a naive average of untreated units. Although the model fits the data well and suggests a substantial negative effect, the lack of statistical significance limits the strength of the causal interpretation.

Table 5: Synthetic Control Results for Tertiary Enrollment

Statistic	Value
Average ATT Estimate	-11
p-value (Joint Null)	0.53
L2 Imbalance	1.285
Percent improvement from uniform weights	80.4%

Figure 3 below plots the estimated treatment effects of the Gelmini reform on Italy's tertiary education enrollment over time, using the synthetic control method. The vertical dashed line at 2010 denotes the year the reform was implemented. In the years preceding the reform, the synthetic control closely tracks Italy's actual enrollment trend, indicating a good pre-treatment match between the treated unit and its synthetic counterpart. However, the estimated effects begin to decline slightly even before the reform, particularly from 2008 onward, suggesting that some of the decline in enrollment may have been anticipated or influenced by earlier policies or other exogenous factors.

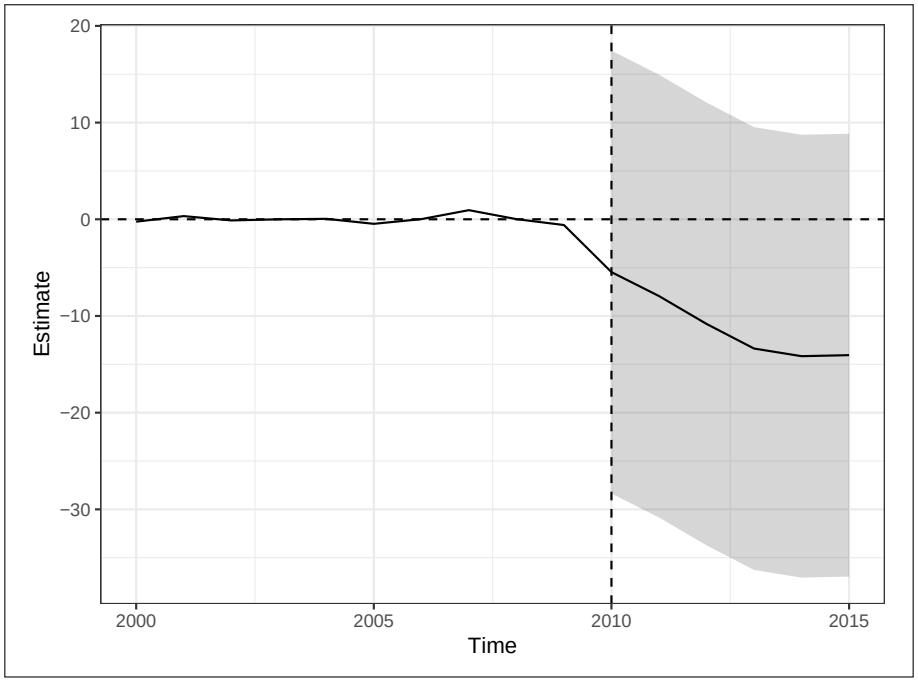

Figure 3: Synthetic control plot comparing Italy to synthetic control.

After 2010, the treatment effect becomes more pronounced, with enrollment rates in Italy diverging

sharply from the synthetic control and dropping by nearly 15 percentage points by 2015. The consistent negative trajectory supports the interpretation that the reform had a substantial adverse effect on tertiary enrollment, but the widening of the shaded confidence intervals post-2010 indicates growing uncertainty in the estimates.

Table 6 below displays the weights assigned to each control country in the construction of the synthetic Italy used in the model. These weights are determined based on how closely each country's pretreatment enrollment trend resembles that of Italy. Countries with higher positive weights, such as Estonia, Ireland, Iceland, Slovenia, and Switzerland contribute more significantly to the synthetic control because their pre-2010 enrollment trajectories are most closely aligned with Italy's. Those with lower weights, such as Denmark and Finland still contribute to the synthetic control group, but to a lesser extent. All other countries received a weight of 0.000 because they were not used in constructing the synthetic control group. These results indicate that the model primarily relied on a small subset of countries (only seven countries have positive weights) to closely replicate Italy's pre-reform enrollment path, which affects the precision of the model.

Table 6: Synthetic Control Weights Assigned to Control Units

	V1
Belgium	0.000
Czechia	0.000
Denmark	0.028
Estonia	0.232
Finland	0.054
France	0.000
Iceland	0.193
Ireland	0.166
Lithuania	0.000
Norway	0.000
Romania	0.000
Slovenia	0.132
Spain	0.000
Sweden	0.000
Switzerland	0.195
United Kingdom	0.000

6.4 Results from the Within-Italy Analysis

The results from the continuous DiD model across 51 Italian universities show a negative and statistically significant relationship between treatment exposure—where lower-ranked institutions are more exposed to funding cuts—and university enrollment following the 2010 Gelmini reform. Specifically, the coefficient for the interaction term (`Post_reform:Exposure_Score`) is -0.04607 and it is significant at the 0.01 level (p

= 0.0069). This suggests that, after the 2010 Gelmini reform, universities with lower rankings—and thus greater exposure to performance-based funding cuts—experienced larger declines in enrollment compared to better-ranked institutions. Since the dependent variable is in logarithmic form, the coefficient can be interpreted approximately as a percentage change. A one standard deviation increase in exposure (that is, moving toward worse-ranked universities) is associated with a 4.6% decrease in enrollment after the reform, relative to universities with better rankings. The high adjusted R-squared (0.9917) indicates that the model explains a substantial portion of the variance in enrollment, largely because of the inclusion of university and year fixed effects.

Table 7: Within-Italy DiD Regression Results

	(1)
Post-reform × Exposure Score	−0.046**
	(0.016)
Num. obs.	561
Num. groups: University	51
Num. groups: year_clean	11
R^2 (full model)	0.993
R^2 (proj model)	0.101
Adj. R^2 (full model)	0.992
Adj. R^2 (proj model)	0.099

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$. Standard errors clustered by university.

Figure 4 below shows the average log enrollment over time for high vs low ranking universities. First, I divided the 51 universities into two groups, High Ranking and Low Ranking, based on whether their Scimago rank was above or below the median rank in the sample. Universities with a rank worse than the median (higher numerical rank) were classified as "Low Ranking", while those with a rank better than the median were classified as "High Ranking". Next, I calculated the average log enrollment for each group by year, which allows me to observe how enrollment trends evolved over time for higher-ranked and lower-ranked universities.

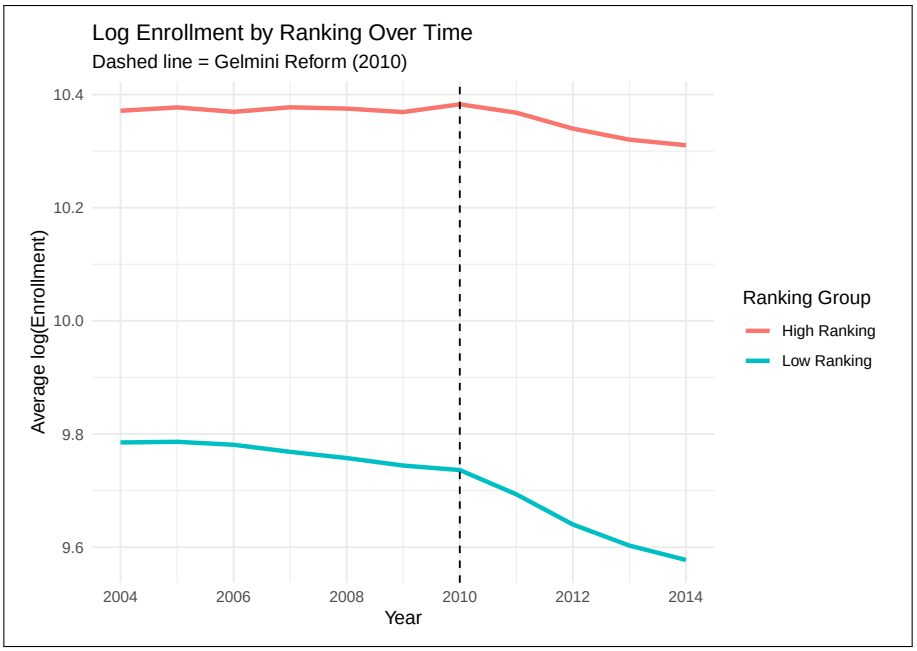

Figure 4: Average log enrollment by university ranking group over time. Dashed line marks the Gelmini reform (2010).

Before 2010, both groups exhibited relatively stable trends in enrollment, with high ranking universities consistently showing higher average enrollments than low ranking universities. After the reform, however, there is a clear drop in enrollments, especially in low ranking institutions. Enrollment in high ranking universities dropped from 10.4 to 10.3 after 2010, which corresponds approximately to a 10% decline. Across low ranking universities, enrollment declined from around 9.8 to less than 9.6, which corresponds to a more than 20% decline. This plot supports the results of the continuous DiD analysis, suggesting that lower-ranked universities, which were more exposed to performance-based funding cuts introduced by the Gelmini reform, faced larger enrollment declines compared to their higher-ranked counterparts.

7 Discussion of Results

In this section, I present and interpret my findings from both the cross-country and within-Italy analyses. I situate the results within the broader context of my research question, examining what they suggest about the impact of the Gelmini reform—and, more broadly, public spending cuts—on Italy's low levels of tertiary education attainment. In doing so, I also reflect on the methodological limitations of my approach, including data availability issues, and the violation of key assumptions. Finally, I offer suggestions for how future research could build on this work to better understand what explains Italy's persistently low levels of tertiary education attainment.

7.1 Cross-Country Analysis

My cross-country analysis does not find statistically significant evidence that the Gelmini reform caused a decline in tertiary education enrollment in Italy relative to other European countries. In other words, I cannot reject the null hypothesis of no effect. However, this does not imply that the reform had no impact on enrollment rates whatsoever. On the contrary, both the regression results and the graphical analyses show a noticeable divergence between the treated and control groups after 2010: while gross enrollment rates in most European countries continued to rise, Italy's rate declined sharply. The lack of statistical significance in my analysis is primarily due to methodological limitations.

First, the synthetic control method relied on a short pretreatment period and a small "donor" pool of countries to construct the synthetic control group, affecting how well the counterfactual resembles Italy's pretreatment trends. The pretreatment period covers 2000 to 2009, which is too short to fully capture trends in the treated and control countries and construct a reliable counterfactual. The longer the pretreatment period, the better the SCM can match the trends between the treated and control units. As a result, only seven countries from the donor pool were assigned non-zero weights in the construction of the synthetic control. Most of the countries receiving non-zero weights were Northern European, including Iceland, Denmark, and Finland. This outcome is somewhat unexpected given the substantial social, economic, and cultural differences between these countries and Italy. This likely reflects the lack of available data for countries more comparable to Italy, such as Portugal and Greece. As a result, the synthetic control group did not accurately represent what Italy's trajectory would have been without the reform, making it difficult to identify a statistically significant treatment effect. A broader donor pool of countries and a longer pretreatment window might allow for a more precise estimation of the reform's effects.

Second and most importantly, the parallel trends assumption required to conduct the difference-in-differences analysis was violated. When plotting the raw enrollment rates for Italy and the control group it is clear that the trends were parallel up until 2007 and then they started diverging. Beginning in 2008, the gross enrollment rate in Italy begins to decline substantially, while it continues to increase relatively linearly in the control group. This violation of parallel trends likely obscures the potential effects of the Gelmini reform on tertiary education enrollment. In other words, while the reform might still have had an impact on gross enrollment rates in Italy relative to other European countries, this effect is not detectable because it becomes absorbed into the already declining trend in enrollment rate that started in 2008. What, then, happened around 2008 that caused enrollment rates to drop sharply and complicate the identification of the reform's impact? In the following sub-sections I explore five different hypotheses that may help explain what happened.

7.1.1 Spending Cuts to Higher Education Were Introduced Prior to 2010

One possible explanation is that key structural changes to the higher education system were already underway before the Gelmini reform was implemented in 2010. As mentioned in section 3, law 133/2008 already introduced significant changes to the higher education system, which may have caused the decline in university enrollment to begin before the Gelmini reform. This decree imposed deep cuts to the Ordinary Financing Fund (FFO), implemented strict restrictions on faculty hiring, and encouraged the financial restructuring of public universities. Cuts to the FFO were envisaged to be rolled out progressively, reducing funds by €63.5 million in 2009 and reaching €455.6 million by 2013. Additionally, the decree capped turnover by limiting new hires to just 1 in 10 retirees in 2009, 1 in 5 in 2010–2011, and 1 in 2 in 2012—regardless of a university's fiscal performance or adherence to salary expenditure limits (*DL 112 (legge 133)* 2009). However, if we look at the data on FFO change over time, we do not observe the spending cuts proposed in the decree 133/2008.

Table 8: Variation in the FFO (2008–2013), source: UDU

Area	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**% Change 2008–2013**
North	2,943,454,544.30	3,185,320,836.49	3,206,893,735.46	2,868,598,461.84	2,811,881,480.38	2,810,953,220.06	-4.5%
Center	1,957,883,923.94	2,076,920,502.70	1,893,344,411.97	1,837,941,034.29	1,779,679,350.88	1,708,711,164.72	-12.7%
South	2,485,242,328.63	2,381,020,946.77	2,646,720,909.20	2,303,384,298.85	2,085,432,490.65	2,065,726,537.28	-16.9%
Italy	7,386,580,796.87	7,643,262,285.96	7,746,959,056.63	7,009,923,794.98	6,676,993,321.91	6,585,390,922.06	-10.8%

While between 2008 and 2013, the FFO went down by 10.8% across the nation, the decline didn't begin until 2011. Based on the above data, the FFO actually increased from approximately €7.34 billion in 2008 to €7.74 billion in 2010. The sharp decline came later, between 2011 and 2013, when the FFO dropped by over €1 billion in three years. If law 133/2008 was a primary driver of the decline in enrollment rates, which began in 2008, we would expect the FFO to also go down in 2008. Yet, it does not go down until 2011, which corresponds to the year in which the Gelmini reform gets implemented. It is therefore unlikely that enrollment rates started falling as a direct consequence of the DL 133/2008.

7.1.2 Increase in Tuition Fees and Reduction in Financial Aid

Although cuts to the FFO did not officially begin until after 2010, it is possible that universities, anticipating reduced funding, began to raise tuition fees or limit scholarships earlier. To test this hypothesis, I gathered data from several historical MIUR publications on annual student contributions, summarized in the table below. The data show a steady increase in tuition over time. Between 2003/2004 and 2009/2010, the median student contribution in public universities rose by 33.94%, while in private universities it increased by 44.48%. Between 2007/2008 and 2008/2009—the period when the gross enrollment rate began to slow down—median student contributions rose only modestly: by 0.17% in public universities and 1.47% in private ones. Between 2008/2009 and 2009/2010, however, contributions increased by 7.83% in public universities and by 1.51% in

private universities, a more significant increase relative to the previous year. In this period of time we also observe a larger drop in enrollment rate, which goes down by almost one full percentage point. The increase in tuition fees may therefore have partly contributed to the drop in enrollment rates. My skepticism of this hypothesis, however, comes from the fact that similar percentage increases had occurred in earlier years—for example, the 7.24% increase between 2005/2006 and 2006/2007—but did not lead to a reduction in the gross enrollment rate.

Table 9: Median student contribution in public and private universities (2003–2010), source: MIUR

Years	**Median Student Contribution in Public Universities (Undergraduate)**	**% Change for Public Universities**	**Median Student Contribution in Private Universities (Undergraduate)**	**% Change for Private Universities**
2003/2004	701.14	—	2,859.30	—
2004/2005	743.70	+ 6.07%	2,970.86	3.90%
2005/2006	757.42	+ 1.84%	3,313.90	11.54%
2006/2007	812.27	+ 7.24%	3,466.81	4.61%
2007/2008	869.71	+ 7.07%	4,010.53	15.67%
2008/2009	871.21	+ 0.17%	4,069.46	1.47%
2009/2010	939.38	+ 7.83%	4,130.66	1.51%
Change 2003/2004 – 2009/2010	+238.24	**+ 33.94%**	+1,271.36	**+ 44.48%**

While there exist significant regional disparities in median tuition fees paid by university students in Italy, which are not captured in the aggregate data reported in table 9, tuition fees tend to be proportional to regional income levels. The North-West is the most expensive area to pursue higher education, followed by the North-East, the Center, the South, and finally the Islands (MIUR 2008). For example, a student enrolled in a bachelor's program at a public university in the North-West pays more than twice as much in tuition as a student in the Islands. However, the household income of a student at the University of Catania is, on average, half as much as that of a student at the Politecnico di Milano (Viesti 2024). Hence, while tuition fees are higher in the North, that does not mean that students in the North are more negatively affected, because they also tend to have higher household incomes.

A significant reduction in financial aid, especially to low-income families, could also explain the decline in enrollment rates. The Diritto allo Studio (DSU)—translated to "right to education"—is a government program that offers financial aid to low-income students. To understand its potential impact, I gathered data on both the number of scholarships awarded and the total funding allocated to the DSU over time and reported the data in the table below. Between 2001 and 2010, the number of scholarships increased

by 20.96% and the amount of euros allocated to the DSU also increased substantially, by 22.89%. The percentage change in scholarships and funding for the DSU from year to year is generally positive, indicating steady increase in the resources allocated to students' financial aid over time. There is a 3.10% reduction in the number of scholarships awarded to students between 2007/2008 and 2008/2009, but the number goes back up by 3.82% in the following year, which is when we observe a more significant drop in enrollments. Moreover, the percentage of students on financial aid remained stable, although very small, throughout the period from 2004/2005 to 2009/2010, sitting around 10.5% for Undergraduate students. Hence, I think that reductions in financial aid are unlikely to be the driving factor of the drop in enrollment rates observed around 2008.

Table 10: Number of scholarships and euros allocated to DSU (2001–2010), source: MIUR

Years	**Number of scholarships**	**% Change in number of scholarships**	**€ allocated to scholarships (thousands of euros)**	**% Change in € allocated to scholarships**
2001/2002	128,971	—	346,973	—
2002/2003	127,732	-0.96%	350,671	+1.07%
2003/2004	132,011	+3.35%	345,412	-1.50%
2004/2005	140,365	+6.33%	363,313	+5.18%
2005/2006	139,055	-0.58%	357,540	-1.59%
2006/2007	154,052	+10.38%	390,373	+9.18%
2007/2008	155,088	+0.67%	418,960	+7.32%
2008/2009	150,281	-3.10%	422,214	+0.78%
2009/2010	156,009	+3.82%	426,403	+0.99%
Change 2001–2010	+27,038	+20.96%	+79,430	+22.89%

7.1.3 Reduction in the Number of High School Graduates

It is possible that the source of the university enrollment decline does not lie in changes to the tertiary education system, but rather to the upper-secondary system (high school). If there are less students graduating from high school, it follows that there will be less students enrolling in university that same year. A decline in High School graduates could be linked to a general decline in the population due to less births, or to specific policies that negatively affected the secondary education system. However, based on the graph below, the number of high school graduates (red line) remained relatively stable between 2000 and 2012, while the number of students enrolling in university (blue line) continued to go down since 2004 (MIUR 2013). Therefore, I reject the hypothesis that the decline in university enrollments is linked to a reduction in the number of high school graduates.

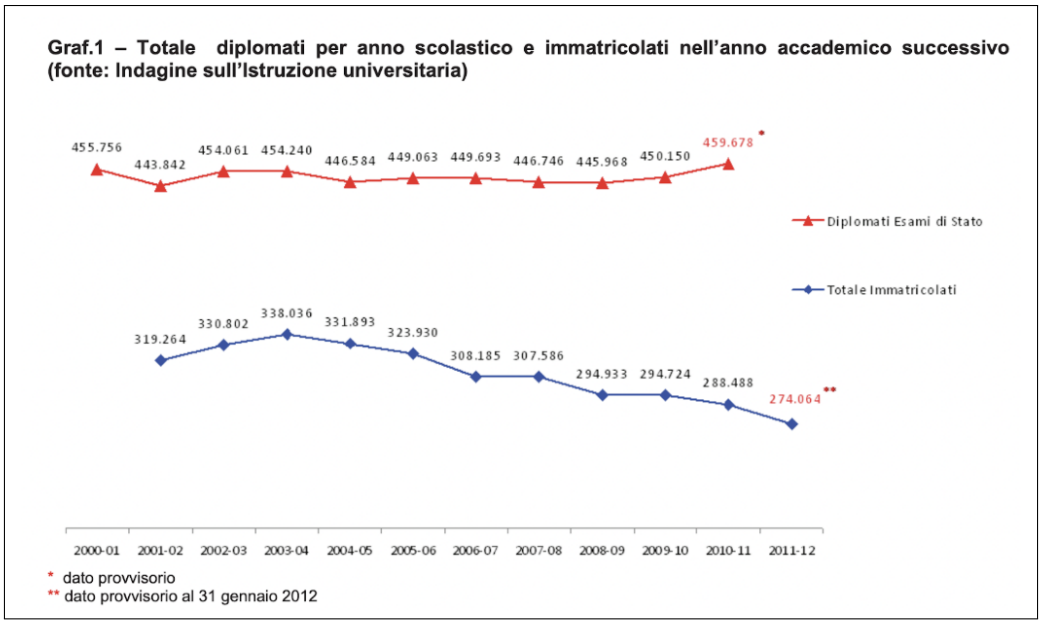

Figure 5: Graph of the total number of high school graduates and total number of students enrolled university (2000-2012), source: MIUR

7.1.4 2008 Financial Crisis and Countercyclical Education Choices

Whether the 2008 financial crisis played a role in the observed fall in Italy's gross enrollment rates is not immediately clear. On the one hand, if prices increased significantly as a result of inflation, the cost of higher education may have become harder for families to afford, leading to a drop in enrollments. On the other hand, choices to enroll in higher education may also be countercyclical: during a recession the opportunity cost of attending university is lower, because the unemployment rate is high, so students may prefer to invest in further education rather than being unemployed or trying to enter a weak labor market.

First, I tested the countercyclical hypothesis by plotting the unemployment rate among people aged 15 to 24 from 2004 to 2019 and comparing it to the gross enrollment rate. Figure 6 shows that enrollment does not exhibit countercyclical behavior: when youth unemployment is low (indicating a strong economy), enrollment rates increase; when unemployment rises (indicating a weak economy), enrollment rates decline. Specifically, youth unemployment skyrockets between 2008 and 2014, the period of the Great Recession and the Italian Sovereign Debt crisis. At the same time, gross enrollment falls dramatically. When youth unemployment goes down after 2014, enrollment rates start going up again. Hence, decisions to enroll in university in Italy are clearly cyclical, and it is possible that the 2008 financial crisis affected people's ability and decisions to enroll in university.

Figure 6: Youth Unemployment Rate vs Gross Enrollment Rate (2004-2019)

I then tested the hypothesis that the 2008 financial crisis led to the drop in gross enrollment rate, by looking at the Consumer Price Index (CPI) and the households' real disposable income in Italy relative to the EU average. I am comparing Italy to the EU average because, if the financial crisis had a similar impact on both Italy and the EU as a whole—reflected in comparable changes in inflation and household income—then Italy's steep drop in university enrollment cannot be attributed solely to macroeconomic conditions, and there must be some other factors driving down enrollment rates in 2008 and 2009. In contrast, if Italy experienced a more severe or prolonged economic downturn than the EU average, this could help explain why enrollments declined more sharply. The CPI, which measures the inflation rate, increased by about 83% in Italy between 2007 and 2008, and fell by 77% in 2009 (MacroTrends 2025b). In the European Union, CPI increased by about 66% from 2007 to 2008, and fell by 80% in 2009 (MacroTrends 2025a). Inflation in Italy rose somewhat more sharply than in the EU average in 2008, but the drop in 2009 was of similar magnitude. These differences, while noticeable, are not large enough to explain why Italy's enrollment trend diverged so significantly from its European peers.

The data on real disposable income of households, on the other hand, suggest that Italy experienced a sharper and more prolonged economic downturn than the European Union average, in 2008 and 2009. In Italy, the household disposable income fell by approximately 2% in 2008 and 2009 compared to a marginal decline of 0.8% across the EU (Eurostat 2021). This suggests that Italian households were more affected by the crisis than the average EU country, likely facing greater financial constraints and uncertainty. In this

context, it is reasonable to assume that Italian higher education—which is already one of the most expensive in Europe—became even less affordable for many Italian families. Students may have opted out of university enrollment in order to contribute to household income or avoid accumulating costs they could no longer justify. While the financial crisis alone may not fully explain the decline in university enrollments, it likely intensified the impact of other factors.

7.1.5 Data Inconsistencies

Finally, I hypothesized that the observed decline in enrollment rates stems from data-related issues rather than changes in public spending, student behavior or economic conditions. To explore this hypothesis, I conducted a closer examination of the underlying data. During this process, I identified some inconsistencies that could help explain the apparent drop in enrollment in 2008. My initial suspicion was that the dataset on gross enrollment rates I used until now—compiled by Our World in Data—might be inaccurate or misaligned with national statistics. To verify this, I cross-referenced this dataset with enrollment data published by the Italian Ministry of Education, Universities and Research (MIUR), aiming to determine whether the trends reported at the international level were consistent with domestic sources. This is where I find some inconsistencies. First, Italian sources distinguish between students who enroll in university for the first time (*immatricolati*), and those who are enrolled in the system overall (*iscritti*). *Immatricolati* refers specifically to students who are accessing the university system for the first time during a given academic year. *Iscritti*, on the other hand, includes all students enrolled in the system as of July 31st of a given year—this includes first-year students and continuing students (Ustat 2019). In other words, *immatricolati* is a subset of *iscritti*, and the two metrics reflect different aspects of university participation: new access versus total presence in the system.

After plotting the total gross enrollment rate (*iscritti*) in tertiary education among people aged 18-24 using data from MIUR and ISTAT, the overall trend appears quite similar to that plotted using the Our World In Data dataset (MIUR 2024b; ISTAT 2025). In both graphs, the highest level of enrollment rate was reached in 2007, and the minimum in 2013. The main difference between the two graphs is that in figure 7, the enrollment rate goes back up between 2009 and 2010, before falling dramatically after 2010, while figure 2 shows a linear drop after 2007. More interesting, however, is what emerges from plotting the gross enrollment rate for *immatricolati*. Figure 8 shows the gross enrollment rate for *immatricolati* (MIUR 2024a). The decline begins around 2004, recovers slightly around 2007, and then drops sharply.

By looking at the two graphs side by side, one can see a similar pattern in both plots: the enrollment rate initially rises steadily, then levels off, followed by a decline, a brief recovery, and finally a sharp drop. While the overall trajectory is similar in both plots, the decline in the graph for total students enrolled (*iscritti*)

appears to lag behind the trend in first-time enrollments (*immatricolati*) by approximately three or four years. The enrollment rate for *immatricolati* peaks around 2003/2004, while that of *iscritti* peaks in 2007. This is consistent with the typical duration of university programs in Italy, which is 3-4 years, and suggests that changes in new students enrolled affect the total student population with a delay. This makes sense if the decline in new enrollments is slow and gradual at first, as it would not immediately offset the presence of larger cohorts still progressing through their degrees. Over time, however, as these larger cohorts graduate and are replaced by smaller incoming classes, the total number of enrolled students begins to fall. While the decline in first enrollments doesn't necessarily explain the entire drop in total enrollments—other factors such as drop-out rates may also have had an impact—it certainly plays a significant role, and it indicates that the reduction in enrollment was already underway in 2004, before the broader effects became visible in total enrollment figures.

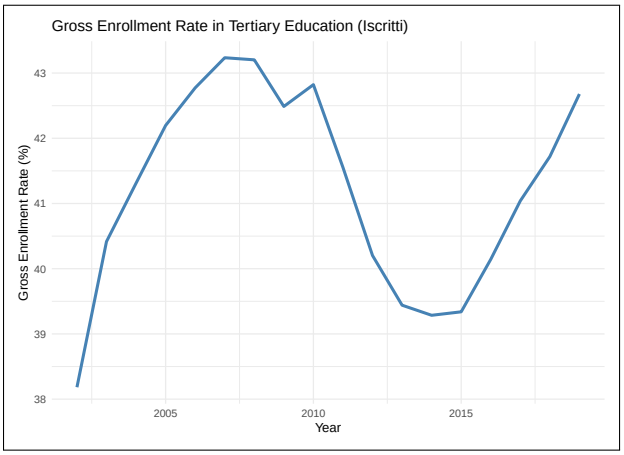

Figure 7: Gross Enrollment Rate for Iscritti.

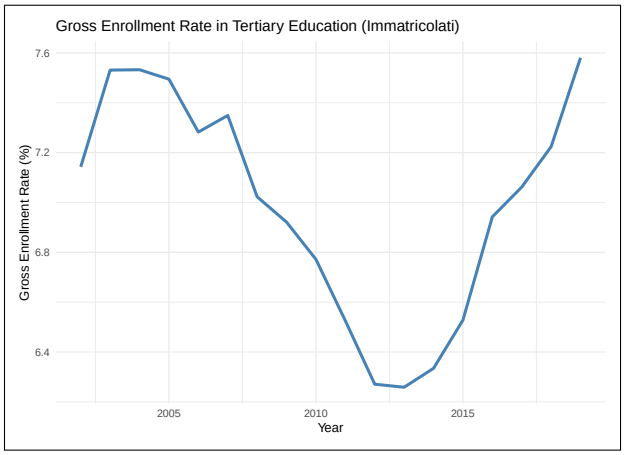

Figure 8: Gross Enrollment Rate for Immatricolati.

After considering various hypotheses, I conclude that the drop in total enrollment rates around 2008 is most likely the result of the lagged effect of the decline in first-time enrollments (*immatricolati*) that began around 2004. Other factors, including rising tuition fees and the 2008 financial crisis, may have further contributed to the decline by causing students to drop-out of school, but the extent of their impact remains uncertain. Future research should investigate the underlying causes of the decrease in the gross enrollment rate of *immatricolati* observed in 2004, and analyze to what extent it affected the drop in total enrollment rate observed in 2008.

7.2 Within-Italy Analysis

While I am unable to conclude that the Gelmini reform was responsible for Italy's lag in tertiary education attainment compared to other European countries, I found significant empirical support for my second

hypothesis: that the reform had a disproportionately negative impact on universities that were already performing worse. Universities that were ranked lower by the Scimago ranking also experienced a more significant reduction in enrollment in the years following the implementation of the reform. Since the Gelmini reform introduced a performance-based funding system for higher education institutions, the observed drop in enrollment among low ranked universities can be linked to the reduction in FFO allocated to these universities. This finding suggests that there exists a causal relationship between public spending and enrollment in higher education, and supports my hypothesis that the Gelmini reform had a heterogeneous effect on tertiary educational outcomes across Italian universities.

This is consistent with the existing literature on the Gelmini reform, which describes how the reform created an elite group of universities that continued to benefit from public investment, while others—especially in Southern Italy—were penalized (Capano 2011; Viesti 2024). In this way, the reform exacerbated long-standing territorial inequalities in the Italian university system. Institutions that had already access to less resources as a result of being located in lower-income regions were those that suffered the most severe funding cuts and saw the steepest enrollment declines. Rather than correcting inefficiencies, the reform further entrenched them, by redistributing resources away from the universities that most needed support.

However, this analysis also has some important limitations, particularly regarding the data used. Due to the inaccessibility of ANVUR's 2010 data on Italian universities' quality and performance, I had to rely on the ranking produced by the Scimago Institutions Ranking, to determine which universities were more or less affected by the new performance-based funding system introduced by the Gelmini reform. The Scimago ranking most likely used different criteria and metrics to evaluate higher education institutions compared to ANVUR, making my results less accurate than if they were produced using ANVUR data. However, in the absence of any better measures, I believe the Scimago ranking is the best proxy for exposure to public funding cuts. Moreover, it is unclear whether the decline in enrollment across low ranking institutions is due to students dropping out of school, less students enrolling in university, students simply moving from low ranking to higher ranking institutions, or all three. This would therefore be an important avenue for further research to investigate.

8 Conclusion

In this paper, I set out to answer an apparently simple question: *to what extent does low government spending on higher education explain Italy's low levels of tertiary education attainment?* I chose to use the Gelmini reform to answer this question, because it provided the perfect setting for a natural experiment. By cutting the Ordinary Financing Fund by over a billion euros in three years, and introducing a performance-based

funding system, the Gelmini reform acted as an exogenous shock to public spending on higher education, and allowed me to test the relationship between public spending and tertiary educational outcomes.

I tested the impact of the reform across two dimensions: 1) on Italy relative to other European countries, and 2) across different Italian universities. Both dimensions tested the relationship between public spending and tertiary educational outcomes, but only the within-country analysis produced significant results. These results suggested not only that lower-ranked institutions experienced a larger drop in enrollments compared to higher-ranked universities after the Gelmini reform, but also that government expenditure on higher education plays a crucial role in tertiary educational outcomes. In fact, lower ranked universities are the ones that were hit the hardest by the funding cuts introduced by the Gelmini reform, and they also experienced a decline in enrollments twice as large as that of higher-ranked institutions. This finding is consistent with the existing literature on the Gelmini reform's impact on tertiary education, and should be taken as additional evidence that investing in higher education is important to increase Italy's tertiary attainment rates. It also raises concerns about the way funding is allocated to higher education institutions, and questions whether a performance-based funding system really improves efficiency or harms students that can't access high-ranking universities.

The cross-country analysis, on the other hand, could not establish a direct causal relationship between the Gelmini reform and Italy's lag in tertiary education attainment relative to other European countries. This does not mean that the reform had no effect on educational outcomes—as demonstrated by the within-country analysis, enrollment started declining much more sharply after 2010. However, a clear causal link cannot be drawn, largely due to methodological limitations. First, the downward trend in enrollment rates had already begun before the reform was implemented, thus violating the parallel trends assumption required for the difference-in-differences analysis. Second, the synthetic control method, which doesn't require the parallel trends assumption to hold, relied on a limited number of "donor" countries and short pretreatment period, which led to high variability in the post-treatment enrollment trends.

Unsatisfied with the insignificance of the cross-country findings, I sought to understand the potential causes behind Italy's apparent decline in gross enrollment rates around 2008. I explored five different hypotheses, from tuition fees and financial aid, to high-school graduation rates, to the 2008 financial crisis, but most of them proved insufficient to explain the sharp drop in enrollments. Ultimately, I realized that the issue lied not in the explanations themselves, but in the period of time I was focusing on. The decline in total enrollment observed after 2007 was not a sudden drop, but rather the delayed consequence of a steady decline in new enrollments that had already begun in 2004. What appeared to be an abrupt change in 2008 was in fact the culmination of a trend that had started years earlier. While this finding is somewhat unsatisfactory, as it still doesn't explain why enrollments started falling before the Gelmini reform was implemented, it

made an important contribution to the literature on the Gelmini reform. By shedding light on the fact that the decline in tertiary enrollment rates was already underway before 2008, I hope this paper can direct future research to explore what factors may have led to the reduction in new enrollments around 2004, instead of focusing solely on total gross enrollment rates.

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Appendix

Appendix A: Code for Cross-Country Analysis

```
#Load libraries
library(dplyr)
library(stringr)
library(tidyr)
library(zoo)
library(ggplot2)
library(readr)
library(tidyverse)
library(fixest)
library(estimatr)
library(modelsummary)
library(texreg)
library(augsynth)

#Load datasets
edu_attainment <- read_csv("Tertairy_Attainment.csv")
edu_spending_1 <- read.csv("spending_1.csv")
edu_spending_2 <- read.csv("Expenditure_2.csv")
edu_enrollment <- read_csv("Tertiary_Enrollment.csv")
gov_spending_GDP <- read_csv("Government_Expenditure_GDP.csv")

#Data Cleaning
edu_attainment <- edu_attainment %>%
  rename(
    Country = geo,
    Year = TIME_PERIOD,
    Tertiary_Attainment = OBS_VALUE
```

```r
  ) %>%
  select(Country, Year, Tertiary_Attainment) %>%  # Keep only relevant columns
  filter(!Country %in% c("Euro␣area␣  ␣20␣countries␣(from␣2023)",
                         "European␣Union␣  ␣27␣countries␣(from␣2020)"))
edu_spending_1 <- edu_spending_1 %>%
  rename(
    Country = geo,
    Year = TIME_PERIOD,
    Education_Spending = OBS_VALUE
  ) %>%
  select(Country, Year, Education_Spending)

edu_spending_2 <- edu_spending_2 %>%
  rename(
    Country = geo,
    Year = TIME_PERIOD,
    Education_Spending = OBS_VALUE
  ) %>%
  select(Country, Year, Education_Spending)

edu_spending <- bind_rows(edu_spending_1, edu_spending_2)

##Merge datasets on Country and Year
attainment_spending <- left_join(edu_attainment, edu_spending, by = c("Country", "Year"))

#Run cross-country lag regression between attainment and spending to show that there is a
    correlation between the two
# Create 4-year lag of education spending
attainment_lagged <- attainment_spending %>%
  arrange(Country, Year) %>%
  group_by(Country) %>%
  mutate(Education_Spending_Lag4 = lag(Education_Spending, 4)) %>%
  ungroup()

##Filter for years where lagged spending is available
attainment_lagged <- attainment_lagged %>%
  filter(Year >= 2000 & Year <= 2020) %>%
  drop_na()

##Run the regression
model_lag4 <- lm(Tertiary_Attainment ~ Education_Spending_Lag4, data = attainment_lagged)
```

```
68
69  summary(model_lag4)
70
71  #Regression between enrollment and attainment
72
73  ##Regression for Italy
74  att_enr_corr_Italy <- lm(Tertiary_Attainment ~ Tertiary_Enrollment, data = att_enr_Italy)
75  summary(att_enr_corr_Italy )
76
77  ##Regression for EU
78  att_enr_corr_total <- lm(Tertiary_Attainment ~ Tertiary_Enrollment, data = att_enr)
79  summary(att_enr_corr_total)
80
81  #Enrollment Analysis
82
83  ##Clean enrollment data
84  edu_enrollment <- edu_enrollment %>%
85    rename(
86      Country = Entity,
87      Tertiary_Enrollment = `Gross enrolment ratio for tertiary education, both sexes (%), GER
            .5T8`)
88
89  gov_spending_GDP <- gov_spending_GDP %>%
90     rename(
91      Country = Entity,
92      Spending_GDP = `Government expenditure on tertiary education as a percentage of GDP (%)
            `)
93
94  ##Create a data set joining enrollment and spending
95  enrollment_spending <- left_join(edu_enrollment, edu_spending, by = c("Country", "Year"))
96
97  enrollment_spending_clean <- enrollment_spending %>%
98    filter(Year >= 2004 & Year <= 2015) %>%  # keep only 2002 onward
99    mutate(
100     Italy = ifelse(Country == "Italy", 1, 0),
101     Post_2008 = ifelse(Year >= 2008, 1, 0),
102     Treated = ifelse(Country == "Italy" & Year >= 2008, 1, 0)
103   )
104
105 ##Filter and clean data
106 edu_enrollment_2010 <- edu_enrollment %>%
```

```r
  filter(Year >= 2000 & Year <= 2015) %>%
  group_by(Country) %>%
  filter(n_distinct(Year) == 16) %>%  # keep only countries with full 2000  2015   coverage
  ungroup() %>%
  mutate(
    Italy = ifelse(Country == "Italy", 1, 0),
    Post_2010 = ifelse(Year >= 2010, 1, 0),
    Treated = ifelse(Country == "Italy" & Year >= 2010, 1, 0)
  )

##Compare enrollment trends between treatment and control
enrollment_trend_plot <- edu_enrollment_2010 %>%
  group_by(Italy, Year) %>%
  summarise(mean_enrollment = mean(Tertiary_Enrollment, na.rm = TRUE)) %>%
  ggplot(aes(x = Year, y = mean_enrollment, color = as.factor(Italy))) +
  geom_line(size = 1.2) +
  labs(title = "Tertiary Education Enrollment (2000-2015)",
       x = "Year",
       y = "Enrollment Rate (%)",
       color = "Country (1 = Italy)") +
  theme_minimal()

#Make Event study plot

##Clean data
edu_enrollment_2010_clean <- edu_enrollment_2010 %>%
  filter(Year >= 2004 & Year <= 2015)

##Create year dummies relative to treatment
edu_enrollment_2010_clean <- edu_enrollment_2010_clean %>%
  mutate(year_rel = Year - 2010)  # 2010 = year of reform

##Create factors for relative year
edu_enrollment_2010_clean$year_rel <- factor(edu_enrollment_2010_clean$year_rel)

##Run event study regression
event_study <- feols(
  Tertiary_Enrollment ~ i(year_rel, Italy, ref = "-1") | Country + Year,
  cluster = ~Country,
  data = edu_enrollment_2010_clean
)
```

```r

summary(event_study)

##Plot event study with 95% CI
iplot(
  event_study,
  main = "Effect on Tertiary_Enrollment",
  xlab = "Years relative to reform (2010)",
  ylab = "Estimate and 95% Conf. Int.",
  ref.line = 0
)

#Run DiD for Enrollment
did_enrollment <- lm_robust(Tertiary_Enrollment ~ Italy + Post_2010 + Italy * Post_2010,
    data = edu_enrollment_2010_clean, cluster = Country)

summary(did_enrollment)

#Synthetic Control Analysis

##Run synthetic control model
syn <- augsynth(
  Tertiary_Enrollment ~ Treated,
  unit = Country,
  time = Year,
  data = edu_enrollment_2010,
  scm = TRUE,
  progfunc = "None",
  #fixedeff = FALSE  # try turning this off
)

summary(syn)
plot(syn)
weights(syn)
```

Appendix B: Code for Within-Italy Analysis

```r
#Load libraries
library(dplyr)
library(stringr)
library(tidyr)
library(zoo)
library(ggplot2)
library(readr)
library(tidyverse)
library(fixest)
library(estimatr)
library(modelsummary)

#Import data
iscritti_ateneo <- read.csv2("02_iscrittixateneo.csv", stringsAsFactors = FALSE)
population_data <- read_csv("Ricostruzione della popolazione 2002-2019.csv")
ranking <- read.csv2("ranking.csv")
immatricolati_anno <- read.csv2("01_immatricolatixanno.csv")
youth_unemployment <- read_csv("youth_unemployment.csv")


#Gross Enrollment Analysis

##Clean data enrollment
enrolled_university <- iscritti_ateneo %>%
  select(Year = AnnoA,
         University = AteneoNOME,
         University_Code = AteneoCOD,
         Gender = SESSO,
         Enrollment = Isc) %>%
  mutate(Year = as.character(Year)) %>%
  group_by(University, University_Code, Year) %>%
  mutate(Total_Enrollment = sum(Enrollment, na.rm = TRUE)) %>%
  ungroup()

###Get rid of gender column in enrollment dataset
enrolled_university_total <- enrolled_university %>%
  select(Year, University, University_Code, Enrollment) %>%
  group_by(Year, University, University_Code) %>%
  summarise(Total_Enrollment = sum(Enrollment, na.rm = TRUE), .groups = "drop")
```

```r

##Clean data population
### Keep only "Total" rows for Gender and ages 18 to 24
population_clean <- population_data %>%
  filter(Sesso == "Totale", Et   == "Totale") %>%
  pivot_longer(
    cols = -c(Et  , Sesso),          # keep 'Et  ' and 'Sesso' as identifiers
    names_to = "Year",             # new column for the years
    values_to = "Age_18_24" # new column for the values
  ) %>%
   mutate(Year = as.numeric(Year))

##Calculate and Plot the gross enrollment rate
### Merge and compute
ger_data <- enrollment_total %>%
  group_by(Year) %>%
  summarise(Total_Enrollment = sum(Total_Enrollment, na.rm = TRUE), .groups = "drop") %>%
  left_join(population_clean, by = "Year") %>%
  mutate(Gross_Enrollment_Rate = (Total_Enrollment / Age_18_24) * 100)

###Plot
iscritti_plot <- ggplot(ger_data, aes(x = Year, y = Gross_Enrollment_Rate)) +
  geom_line(size = 1.2, color = "steelblue") +
  labs(
    title = "Gross␣Enrollment␣Rate␣in␣Tertiary␣Education␣(Iscritti)",
    x = "Year",
    y = "Gross␣Enrollment␣Rate␣(%)"
  ) +
  theme_minimal()


#Scimago Ranking and ENrollment Analysis

##Clean ranking data
ranking_clean <- ranking %>%
  select(Rank, Institution) %>%
  rename(University = Institution) %>%
  left_join(enrolled_university_total, by = "University") %>%
  drop_na()

##Create variables for DiD
```

```r
ranking_enrollment <- ranking_clean %>%
  filter(Year >= 2004 & Year <= 2015) %>%
  mutate(
    year_clean = as.numeric(substr(Year, 1, 4)),
    Post_reform = ifelse(year_clean >= 2010, 1, 0),
    # Invert Rank so higher values = more negatively affected
    Exposure_Score = scale(Rank),
    Log_Enrollment = log(Total_Enrollment)
    )

##Run Continuous DiD using Scimago ranking
model <- feols(
  Log_Enrollment ~ Post_reform * Exposure_Score | University + year_clean,
  data = ranking_enrollment,
  cluster = ~University
)
summary(model)

##Plot High Ranking and Low Rankig Enrollment trends

###Create binary treatment group based on Scimago Rank
ranking_enrollment <- ranking_enrollment %>%
  mutate(Treatment_Group = ifelse(Rank > median(Rank, na.rm = TRUE), "Low Ranking", "High Ranking"))

###Compute average log enrollment by year and group
avg_enrollment <- ranking_enrollment %>%
  group_by(year_clean, Treatment_Group) %>%
  summarise(Mean_Enrollment = mean(Log_Enrollment, na.rm = TRUE), .groups = "drop")

###Plot
ranking_enrollment_plot <- ggplot(avg_enrollment, aes(x = year_clean, y = Mean_Enrollment, color = Treatment_Group)) +
  geom_line(size = 1.2) +
  geom_vline(xintercept = 2010, linetype = "dashed", color = "black") +
  labs(
    title = "Log Enrollment by Ranking Over Time",
    subtitle = "Dashed line = Gelmini reform (2010)",
    y = "Average log(Enrollment)",
    x = "Year",
    color = "Ranking Group"
```

```
  ) +
  theme_minimal()


#Immatricolati Analysis
## Clean data immatricolati
immatricolati_clean <- immatricolati_anno %>%
  mutate(
    Year = as.numeric(substr(AnnoA, 1, 4))) # Extract first year as number

##Merge with population data and compute

imm_pop <- immatricolati_clean %>%
mutate(Imm = as.numeric(gsub("\\.", "", Imm))) %>%
  group_by(Year) %>%
  summarise(Total_Immatricolati = sum(Imm, na.rm = TRUE), .groups = "drop") %>%
  left_join(population_clean, by = "Year") %>%
  mutate(Gross_Enrollment_Rate = (Total_Immatricolati / Age_18_24) * 100)

imm_pop <- imm_pop %>%
  filter(!is.na(Total_Immatricolati), !is.na(Age_18_24), !is.na(Gross_Enrollment_Rate))

##Plot Gross Enrollment for Immatricolati
immatricolati_plot <- ggplot(imm_pop, aes(x = Year, y = Gross_Enrollment_Rate)) +
  geom_line(size = 1.2, color = "steelblue") +
  labs(
    title = "Gross␣Enrollment␣Rate␣in␣Tertiary␣Education␣(Immatricolati)",
    x = "Year",
    y = "Gross␣Enrollment␣Rate␣(%)"
  ) +
  theme_minimal()

#Youth Unemployment Analysis
## Clean unemployment data
youth_unemployment_clean <- youth_unemployment %>%
   filter(
    `Classe di et  ` == "15-24␣anni",
    `Sesso` == "totale",
    `Titolo di studio` == "totale",
    `Durata della disoccupazione` == "totale",
    !str_detect(TIME, "Q")  # Exclude quarterly values
```

```
  ) %>%
  select(contains("Territorio"), TIME, Value) %>%
  rename(Year = TIME,
         Unemployment = Value) %>%
  mutate(Year = as.numeric(Year))

total_unemployment_immatricolati <- youth_unemployment_clean %>%
  filter(Territorio == "Italia") %>%
  left_join(imm_pop, by = "Year") %>%
  drop_na()

##Merge unermployment rate and iscritti
total_unemployment_iscritti <- youth_unemployment_clean %>%
  filter(Territorio == "Italia") %>%
  left_join(ger_data, by = "Year") %>%
  drop_na()

##Plot unemployment rate and iscritti
unemployment_enrollment_plot <- ggplot(total_unemployment_iscritti, aes(x = Year)) +
  geom_line(aes(y = Unemployment, color = "Youth Unemployment Rate")) +
  geom_line(aes(y = Gross_Enrollment_Rate, color = "Gross Enrollment Rate")) +
  scale_color_manual(values = c("Youth Unemployment Rate" = "red", "Gross Enrollment Rate" =
      "blue")) +
  labs(
    title = "Youth Unemployment vs. Gross Enrollment Rate Over Time",
    x = "Year",
    y = "Rate",
    color = "Legend"
  ) +
  theme_minimal()
```