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Abstract

This thesis analyzes the determinants of performance and outcomes of the Italian National Health Service (SSN) through three essays in health economics. The research investigates how regional healthcare performance is influenced by three distinct but interconnected pillars: large-scale external financing, macroeconomic fluctuations, and internal governance reforms. The first essay explores the use of European Structural Funds for the enhancement of Italian regional health systems in the 2014-2020 period. The analysis quantifies the investments, totaling over 6.19 billion euros, of which 5.1 billion from the ERDF (European Regional Development Fund) and over 1 billion from the ESF (European Social Fund). These funds supported almost 27,000 projects, with a primary focus on infrastructure, technological innovation, and personnel training, highlighting a concentration of investments in the regions of Puglia and Campania. The second essay examines the relationship between business cycles and mortality at the provincial level in Italy (2004-2019). Using the unemployment rate as a proxy for macroeconomic conditions and applying panel econometric models, the study finds a pro-cyclical trend in total mortality: an increase in unemployment is associated with a reduction in mortality rates. This effect is heterogeneous, being more significant for men, for the youngest age group, and for individuals with higher education levels. A robustness analysis, extended to 2021, shows how the COVID-19 pandemic disrupted these established dynamics. The third essay evaluates the impact of managerial governance on the performance of Local Health Authorities (LHA), specifically analyzing the reform on the selection of General Managers (Legislative Decree 171/2016). Through the construction of an innovative dataset, which integrates performance data with the curricular characteristics of managers (manually extracted from CVs), and the application of a staggered difference-in-differences (Callaway & Sant'Anna) methodology for the 2015-2021 period, the analysis reveals a negative impact on health quality indicators. The heterogeneity analysis shows that this negative effect is particularly pronounced in regions subject to recovery plans and investigates how the reform affected the educational profile of the appointed managers. Overall, this thesis provides new evidence on the complex dynamics governing Italian healthcare, demonstrating that, although funding is crucial, system performance is profoundly influenced by both external macroeconomic factors and the effectiveness of internal governance reforms.

Introduction

Health Economics (HE) formally established itself as an autonomous and indispensable discipline between the 1950s and 1960s, emerging in response to the post-war explosion of healthcare costs and the growing awareness that the medical sector could not be adequately analyzed using standard market economy models. The necessity for the field arose from the observation that uncertainty, information asymmetries and ethical considerations generate structural anomalies in the functioning of healthcare markets. The theoretical foundation of this discipline was laid by Kenneth Arrow (1963), who delineated the peculiar structure of market failure in healthcare and highlighted how these specific features challenge the conventional assumptions of competitive markets.

Since then, *HE* has become the field dedicated to the study of efficiency, equity and the organization of health systems, consistently confronting a fundamental tension: the virtually unlimited demand for better health outcomes in contrast with the scarcity of available resources to achieve them. In modern welfare states, healthcare is not merely a cost factor, but a crucial investment in human capital, social cohesion and economic productivity.

In this scenario, the analysis of the Italian National Health Service (NHS) offers an especially significant case study. Established in 1978 by Law no. 833, the NHS is founded upon the two fundamental pillars of universality and equality enshrined in Article 32 of the Italian Constitution, aiming to provide uniform care to all citizens regardless of income or geographic location. Primarily financed through general taxation, it is widely recognized as one of the most efficient systems globally in terms of health outcomes relative to expenditure.

Despite this, the system faces profound and persistent challenges, exacerbated by the architecture of fiscal federalism in healthcare. The decentralization reforms of 2001 transferred substantial managerial and financial responsibilities to the Regions. While this process was intended to align services with local needs, it also aggravated a historical North–South divide, effectively creating twenty-one distinct regional health systems operating at varying speeds and levels of efficiency. Structural criticalities persist, particularly in defining the jurisdictional boundaries between State and regional competencies, in assigning the margins of taxing autonomy for service financing, and in the resource allocation mechanisms designated for the Essential Levels of Care (Livelli Essenziali di Assistenza, LEA).

The attempt to hold the Regions accountable for spending—via the balanced budget requirement and the obligation to repay debt through regional taxation—did not yield the desired effectiveness. The failure of the principle of fiscal accountability, as evidenced by rising regional deficits, necessitated corrective intervention by the central government. The introduction of the Recovery Plans in 2007 resulted in a de facto re-centralization of control over healthcare spending, constituting a structural derogation from the principle of autonomy that had underpinned the decentralization reforms.

To provide the necessary theoretical relevance to the Italian context, this research is positioned at the intersection of three main streams in Applied Economics and Health Economics. Firstly, it connects to the debate on public capital efficiency and EU Cohesion Policy, investigating the investment and fund absorption capacity of lagging regions. Secondly, the thesis contributes to the analysis of the socio-economic determinants of health, a consolidated field that, following the tradition of Ruhm (2000), examines the complex relationships between business cycles and health indicators. Finally, the work is situated within the emerging field of the Economics of Governance and Managerial Quality, a field still unexplored within the Italian health sector, aligning with studies such as Bloom et al. (2020) in evaluating the causal impact of leadership human capital and institutional reforms on public sector performance.

Understanding the trajectory of the Italian NHS therefore requires looking beyond simple expenditure indicators and conducting a holistic investigation into the determinants of health and performance. This thesis contributes to such an investigation by dissecting three distinct but interconnected dimensions of the sustainability and effectiveness of the Italian health system: the role of external financial resources (specifically European Structural Funds) in bridging infrastructural gaps; the impact of macroeconomic fluctuations on population health outcomes; and the influence of managerial leadership and governance reforms on the efficiency of Local Health Authorities (LHAs).

This doctoral thesis is composed of three independent essays, each addressing a specific research gap within the literature on health economics and health policy in Italy. Although distinct in their methodological approaches and specific research questions, they are unified by a common objective: to evaluate how financial, economic and organizational factors shape the effectiveness and equity of the Italian healthcare sector.

The first chapter, entitled "European Structural Funds to Finance Healthcare in Italian Regions", focuses on the input side of the healthcare equation: capital investment. In a period characterized by national public investment stagnation, European Structural Funds (European Regional Development Fund, *ERDF*, and European Social Fund, *ESF*) have become a vital lifeline for modernizing healthcare infrastructure and technology, particularly in lagging regions. Despite the magnitude of these funds, the literature lacks systematic evidence mapping their specific allocation in the Italian health sector. Given the non-existence of a dedicated database for analyzing financial allocation within cohesion funds for healthcare, we constructed an original dataset and performed a categorization of funds based on project focus, including health infrastructure, technological innovation, training and healthcare policy reforms. This chapter fills that gap by providing a detailed analysis of how over 6 billion euros were utilized during the 2014–2020 programming period. By examining the distribution of funds among infrastructure, technology and human capital training, the study highlights the crucial role—and the persistent disparities—of EU funding in attempts to harmonize healthcare accessibility across the peninsula. Furthermore, an in-depth analysis is conducted on the COVID-19 pandemic period, considering both the number of projects and the amount of funding allocated to address this shock. In doing so, the chapter lays the groundwork for understanding the material constraints and opportunities within the NHS.

Moving from resources to the broader context, the second chapter, "Business Cycles and Mortality in Italy", examines the contextual determinants of health. The NHS does not operate in a vacuum; it functions within a dynamic economic system in which labour market fluctuations can have profound effects on population well-being. Challenging the conventional view that economic crises are invariably detrimental to health, this study investigates the procyclical nature of mortality in Italy using a provincial-level panel dataset covering the period 2004–2019. Annual mortality rates—disaggregated by cause of death, gender, age group and educational attainment—are linked to the unemployment rate, which serves as the main indicator of the business cycle. The empirical analysis relies on a two-way fixed effects model and is explicitly non-causal in nature, providing a descriptive framework designed to facilitate cross-country comparisons. The results document a predominantly procyclical pattern: increases in unemployment are associated with reductions in overall mortality. This relationship is markedly stronger for men than for women and is driven in particular by deaths from road accidents, suicides and cardiovascular diseases. Heterogeneous effects also emerge across age and education groups, with a statistically significant procyclical response among young individuals (16–24 years) and those with higher educational attainment. Extending the sample to include the COVID-19 years (2020–2021) shows that this unprecedented exogenous shock constitutes a structural break in these historical regularities, attenuating the negative unemployment–mortality association and generating a countercyclical pattern for respiratory-related deaths. Overall, the findings highlight the importance of considering both demographic composition and cause-specific mortality when designing counter-cyclical health policies in a country characterized by deep territorial disparities and recurrent economic shocks.

The third and final chapter, "Leadership Matters? Managerial Turnover, Reform, and Performance in Italian Local Health Systems", turns to the internal drivers of health system performance, focusing on governance quality and the selection of top management. Exploiting Legislative Decree 171/2016 as a quasi-experimental shock to the appointment rules for Local Health Authority (LHA) General Managers, the chapter investigates whether changes in managerial composition translate into improvements in economic–financial and clinical performance. To this end, it constructs a novel LHA-level panel dataset for 2015–2021 that combines Ministry of Health and AGENAS performance indicators, ISTAT socio-economic data, and, crucially, an original longitudinal roster of General Managers documenting all appointments and successions across LHAs over time—a resource that, to the best of our knowledge, is not available either in the existing literature or in official ministerial or LHA sources. This roster is complemented by manually collected curricula vitae of General Managers, providing detailed information on education, gender and professional background. The empirical strategy relies on a staggered Difference-in-Differences framework: traditional two-way fixed effects (TWFE) estimates are complemented by staggered-robust Callaway–Sant'Anna estimators, while Wooldridge's JWDID approach is employed for binary outcomes. The results show that, although the reform substantially altered managerial composition—raising turnover, increasing the share of GMs with non-health degrees in Recovery Plan regions, and modestly expanding female representation—it did not generate systematic gains in economic–financial performance and is associated with a small but robust increase in 30-day mortality after femoral neck fracture. Overall, the chapter suggests that greater formal transparency and meritocratic selection in top management are necessary but not sufficient conditions for better outcomes: in a context of fiscal stress, staff shortages and heterogeneous regional governance, the performance impact of leadership reforms critically depends on how new managers' skills interact with binding organizational and institutional constraints.

Taken together, these three essays offer a comprehensive view of the multidimensional challenges facing the Italian NHS. They suggest that guaranteeing the system's sustainability requires a multi-level approach:

- Strategic investment: maximizing the utility of European funds through better coordination and reducing regional fragmentation.
- Adaptive policy formulation: recognizing that economic booms and downturns, captured also by unemployment dynamics, entail different health risks and therefore require targeted interventions for specific demographic groups and causes of death.
- Managerial professionalization: moving beyond formal compliance in governance reforms to genuinely value human capital and leadership capabilities in health administration.

The insights derived from this thesis provide empirical evidence that can assist policymakers in preserving the universalistic nature of the NHS while simultaneously enhancing its resilience and efficiency.

Chapter 1

European structural funds to finance healthcare in Italian regions

In this work, we explore the extensive utilization of European Union Structural Funds to enhance regional healthcare systems in Italy over the period 2014-2020. These funds serve as vital instruments for financing the construction, renovation, and modernization of healthcare facilities, as well as supporting medical research and technological innovation. They enable the implementation of disease prevention and health promotion programs and provide essential income support to vulnerable families through the European Social Fund.

Our analysis found that EU funding allocated to ”health-related” projects during the 2014-2020 programming period, amounts to just over 6.19 billion euros (5.1 billion financed by the European Regional Development Fund (ERDF) and just over 1 billion financed by the European Social Fund (ESF)), of which 65.88% is funded by European resources. These funds supported a total of 26,739 projects, with 22,529 funded by the ERDF, primarily focusing on infrastructure projects and the acquisition of new technologies in the healthcare sector. Meanwhile, the 4,210 projects funded by the ESF were dedicated to personnel training and public health policies in the regions. The European co-financing provided by the ERDF exceeded 63%, while for the ESF, the European share was approximately 77%.

Notably, some regions have leveraged these funds to pioneer telemedicine and healthcare technologies, improving healthcare accessibility, especially in remote areas. However, regional disparities in fund allocation and utilization persist and coordinated strategies and cross-regional collaboration, emphasizing the sharing of best practices and the reinforcement of transnational projects, need to successfully address these calls and to promote convergence not only in economic but also in healthcare terms.

Keywords: European Union • Structural Funds • Healthcare • Investments • Italy.

JEL Classification: F15 • I18 • H51 • H54 • H77 • F15 • R11

1.1 Introduction

European Structural Funds are long-term financing programs aimed at reducing economic and social disparities within the European Union by promoting regional development, economic and social cohesion, and competitiveness. Among the most well-known structural funds are the European Regional Development Fund (ERDF) and the European Social Fund (ESF), which cover almost 80% of the total structural funds[1]. The ESF, on the other hand, focuses on improving employment opportunities, education, and social inclusion. It funds initiatives to enhance skills, job prospects, and social cohesion, targeting disadvantaged groups to reduce inequalities.

The European Structural and Investment Funds (ESIF) play a crucial role in catalyzing improvements in healthcare systems across member states. For instance, in Slovakia, during the 2007-2013 programming period, ESIF invested 237 € million in Slovak hospitals, which led to statistically significant improvements in certain healthcare quality measures, such as the readmission rate within 30 days. This demonstrates that while ESIFs are not primarily intended for healthcare financing, they can significantly enhance healthcare infrastructure and service delivery (Fidrmuc et al., 2022).

European structural and investment funds are not specifically intended for healthcare financing, they can have an indirect impact on investments in this sector, depending on the policies and spending priorities of each region. These two funds can allocate a portion of EU resources to improve healthcare infrastructure, promote technological innovation in the medical field, train healthcare personnel, and enhance accessibility to healthcare services in different regions (Neagu et al., 2017). They can also serve as a valuable source of funding for policies aimed at supplementing the income of people with disabilities who require assistance. Furthermore, the use of these funds has been associated with significant improvements in healthcare outcomes in various

[1] The Partnership Agreement between the EU and Italy, adopted on October 29, 2014, and subsequently revised in February 2018, outlines the strategic framework and the selection of thematic objectives for which investments funded by the European Structural and Investment Funds (ESIF) are focused. In total, it represents approximately 44.8 billion euros of EU resources allocated to Italy, with over 36 billion euros specifically earmarked for cohesion policy, through the European Regional Development Fund (ERDF) and the European Social Fund (ESF).

member states (McCarthy, 2011).

The allocation and specific use of structural funds, however, depend on the priorities of each Member State and the funding programs established in agreement with the European Commission. For instance, Hungary and Slovakia have implemented various measures to improve fund absorption and achieve strategic development goals, thereby enhancing public service infrastructure, including healthcare (Dorin-Madalin, 2015). In some cases, health-related projects funded by structural funds have led to reductions in health inequalities and better access to healthcare services, as noted by Neagu et al. (2018). The integration of health equity into the structural funds' framework has been an evolving process, adapting to the shifting priorities within the EU's broader socio-economic goals.

While there is extensive literature on the impact of Cohesion funds on growth in various European regions (e.g., Mohl & Hagen, 2010; Dall'Erba & Fang, 2017), there are still too few studies that have specifically analyzed the impact of structural funds on regional healthcare system investments.

For instance, Vukašina et al. (2022) examined the impact of European Structural and Investment Funds (ESIFs) on regional development in the new EU member states, finding that an increase in ESIF per capita by 1% contributed to a GDP per capita increase of 0.0053% to 0.008%, depending on the model used. Similarly, Jánošková (2023) analyzed the effect of ESIFs on economic indicators in Slovakia, concluding that there is a dependence between the implementation of ESIFs and both GDP per capita and unemployment rates, although the impact on GDP was relatively low.

Specifically focusing on healthcare, Murauskiene and Karanikolos (2017) demonstrated how structural funds improved healthcare infrastructure in Lithuania, with clear results on clinical outcomes. The study also highlights that in Lithuania, a portion of European resources was invested in training programs for doctors, nurses, and other healthcare professionals. Similarly, Tijanić and Kersan-Škabić (2023) have shown that investment in healthcare infrastructure through structural funds has had a positive impact on the quality of healthcare services and accessibility in Croatia. Medeiros (2014) highlighted how Cohesion funds were used in Portuguese regions to improve hospitals, clinics, medical research facilities, and other healthcare services. Research on Central and Eastern European countries has shown that these funds significantly contributed to public health infrastructure improvements, economic growth, and overall regional development (Dorin-Madalin, 2015).

Other works (McCarthy, 2012;McCarthy & Zeegers Paget, 2013) reported in their analysis a series of projects implemented in various Eastern European and Mediterranean regions where Cohesion funds were used to support medical and scientific research, promoting innovation and the development of new medical or pharmaceutical technologies, thus improving the quality of care provided. Furthermore, especially the ESF is explicitly designed to invest in disease prevention and health promotion programs to reduce long-term healthcare costs. According to McCarthy (2011), the allocation of structural funds for health in new member states has been crucial for developing public health infrastructure and services. Healthcare investments can create new jobs, thus contributing to the economic and social development of the region and reducing health disparities (Santana et al., 2020; Hermans et al., 2023). Holecki et al. (2020) described a series of public healthcare interventions funded by European structural funds in Visegrad countries (Poland, Czech Republic, Slovak Republic, and Hungary). Even more recently, Dubas-Jakóbczyk and Kozieł (2022) emphasized how EU structural funds constituted an important source of infrastructural investments in Poland, especially for public hospitals. Moreover, Tijanić and Kersan-Škabić (2023) highlight the role of structural funds in supporting healthcare policy reforms and promoting health equity in Croatian regions.

Despite Italian regions receiving a significant amount of structural funds, to our knowledge, there are currently no studies mapping healthcare investments in different Italian regions. This gap in the literature indicates a need for more comprehensive studies to understand the impact of structural funds on healthcare systems at the regional level in Italy, emphasizing the need for comprehensive analysis to optimize fund utilization. Therefore, the purpose of this work is to provide regional data on community funds aimed at infrastructure, technological, and training development in the healthcare field and, more broadly, on all policies that can impact public health policies in Italian regions.

In Italy, regional healthcare expenditure is allocated through a funding system known as the "*Accordo di Programma Quadro*" (APQ)[2]. This agreement establishes the criteria and modalities for the distribution of financial resources between the State and the regions for financing the National Health Service (SSN). The allocation of structural funds, on the other hand, is carried out through specific programs and projects activated at the regional level in agreement with the European Commission and therefore represents additional resources beyond the funding provided by the State.

1.2 Data

To analyze the Cohesion funds dedicated to healthcare investments, we consulted the *OpenCoesione database* (OpenCoesione - Home). The OpenCoesione Database is an Italian project aimed at providing transparency and accessibility to information regarding public funds allocated to cohesion projects in Italy. This database collects information from various sources, including public entities and institutions responsible for managing the funds. These data include information on funded projects, allocated resources, and the regions involved. The main goal of the platform is to enable citizens, researchers, non-governmental organizations, and other stakeholders to monitor and evaluate the use of public funds for cohesion projects. Projects that fall under multiple programming areas are reported in the dataset as a single record containing all the project-related

[2]The APQ was introduced with Law No. 67 on March 28, 1988.

information. The datasets are updated bi-monthly and published approximately three months after the reference date. The minimum reporting unit is the project. In our work, all information is associated with projects financed with a unique project identification code called CUP. The analysis presented here uses data available for the programming period 2014-2020, updated as of April 2023.

There is no unique dimension that identifies healthcare projects. Therefore, following the approach of Dubas-Jakóbczyk and Kozieł (2022), we identified all projects as ”health-related,” taking into account both the type of specific priority/task under which the project was realized (e.g., Priority: investments in health infrastructure) and the type of beneficiary (e.g., health services provider, Ministry of Health, Municipalities, etc.).

The projects were aggregated based on the funding source. In order to better categorize the investments, we analyzed projects financed by the ERDF, which mainly include projects for the infrastructure and technological enhancement of regional healthcare systems (both public and private), and projects financed by the ESF, which are related to professional training of medical and nursing staff, health improvement policies in workplaces, educational programs from childhood to old age, income support programs for non-self- sufficient individuals, and overall interventions for the improvement of public health.

1.3 Descriptive Analysis of ERDF and ESF Funds

The aggregate analysis of various EU funds allocated to ”health-related” projects during the 2014-2020 programming period amounts to just over 6.19 billion euros (5.1 billion funded by the ERDF and just over 1 billion funded by the ESF), of which 65.88% is financed by European resources (Table 1.1). These resources have funded a total of 26,739 projects, with 22,529 funded by the ERDF, primarily focusing on infrastructure projects and the acquisition of new technologies in the healthcare field. Meanwhile, the 4,210 projects funded by the ESF were dedicated to personnel training and public health policies in the regions. European co-financing provided by the ERDF exceeded 63%, while for the ESF, the European share was approximately 77%.

Table 1.1: Analysis of European co-financing: comparative analysis of co-financing devolved by the European Regional Development Fund (ERDF) and the European Social Fund (ESF) for project implementation at the national level.

Funds	**Projects**	**Total investments**	**EU co-funded**	**EU/Total Investments (%)**
ERDF	22,529	5,177,882,760.63 €	3,293,685,539.48 €	63.61%
ESF	4,210	1,020,848,264.98 €	790,010,665.74 €	77.39%
Total	**26,739**	**6,198,731,025.61 €**	**4,083,696,205.22 €**	**65.88%**

Regarding the recipients of ERDF funds (Figure 1.1), 17.19% of the total resources, including both funds from European sources and state financing, were allocated to municipalities. The 18.11% was directed to public or private entities that directly provide healthcare services (healthcare providers), while the remaining portion, amounting to 64.70%, was allocated to others. This category encompasses various other healthcare service providers such as private companies, educational institutions, non-governmental organizations indirectly providing health and social services.

Looking at the regional distribution of ERDF funds reported in Table 1.2, it is evident that there is significant heterogeneity among regions both in terms of total resources and the number of funded projects. Specifically, the Southern regions of Puglia and Campania received over 983 million euros (with 79% financed by EU contributions), and over 974 million euros (with 68% from EU funding) for investments in infrastructure and new technologies, respectively.

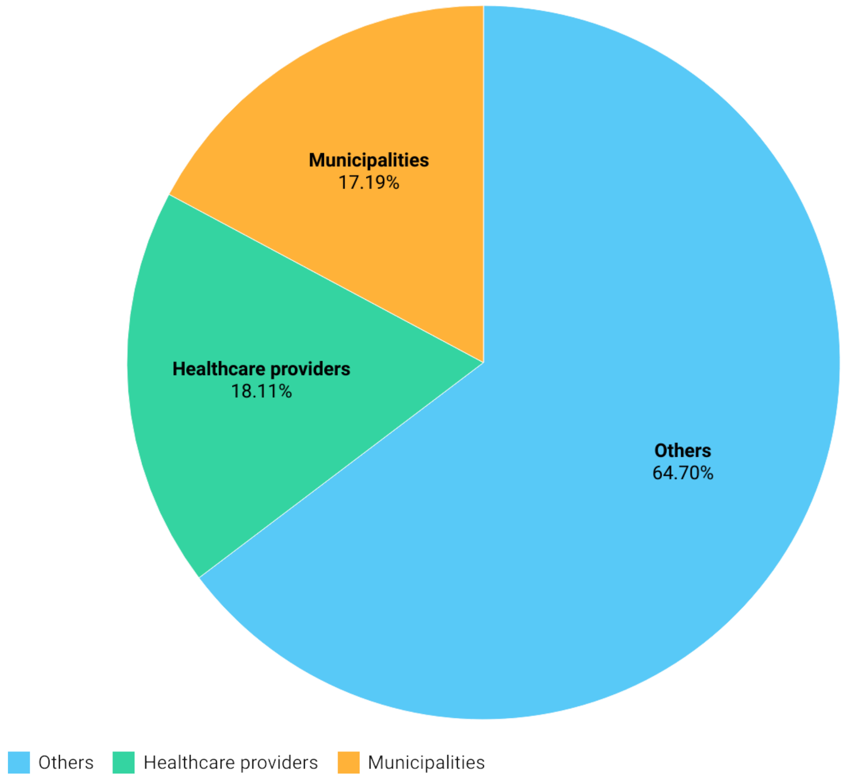
When considering the number of projects (Figure 1.2b), Tuscany leads with 4,223 projects (18.74% of the total), followed by Puglia with 2,561 projects (11.37%) and Campania with 2,516 projects (11.17%). It's not surprising that the highest resources were allocated to the more populous Southern regions, as both Puglia and Campania are part of the Convergence regions, which receive more funding. Many of these investments were directed towards the modernization of healthcare facilities, technological innovation, the implementation of new healthcare monitoring methods such as telemedicine, and the renewal of diagnostic equipment.

Table 1.2: Analysis of European co-financing (ERDF): analysis of co-financing devolved by the European Regional Development Fund (ERDF) for project implementation at the regional level.

REGIONS	Total Investment	EU Co-funded	EU co-funded/ Total investment (%)
Abruzzo	127,680,991.62 €	66,609,723.20 €	52.17%
Basilicata	93,017,215.26 €	66,640,488.47 €	71.64%
Calabria	171,658,999.34 €	127,497,974.49 €	74.27%
Campania	974,607,920.52 €	664,532,826.32 €	68.18%
Emilia-Romagna	247,500,529.30 €	121,729,848.83 €	49.18%
Friuli-Venezia Giulia	48,792,115.62 €	24,413,885.52 €	50.04%
Lazio	429,190,719.48 €	336,960,248.04 €	78.51%
Liguria	43,190,080.94 €	17,187,104.04 €	39.79%
Lombardy	214,166,035.42 €	109,194,320.22 €	50.99%
Marche	110,111,052.49 €	55,522,863.20 €	50.42%
Molise	30,371,873.43 €	23,627,746.99 €	77.79%
Piedmont	221,195,756.17 €	101,945,566.81 €	46.09%
Apulia	983,548,324.63 €	772,864,338.66 €	78.58%
Sardinia	154,249,168.66 €	74,349,275.52 €	48.20%
Sicily	569,582,527.76 €	355,998,716.14 €	62.50%
Tuscany	596,741,552.83 €	264,730,912.29 €	44.36%
Trentino-Alto Adige	17,133,317.99 €	8,544,826.86 €	49.87%
Umbria	29,894,944.96 €	14,798,362.40 €	49.50%
Aosta Valley	24,887,189.13 €	7,720,586.56 €	31.02%
Veneto	170,262,338.22 €	78,815,924.92 €	46.29%
Total	**5,257,782,653.77 €**	**3,293,685,539.48 €**	**62.64%**

Source: author’s elaboration on OpenCoesione data (April 2023)

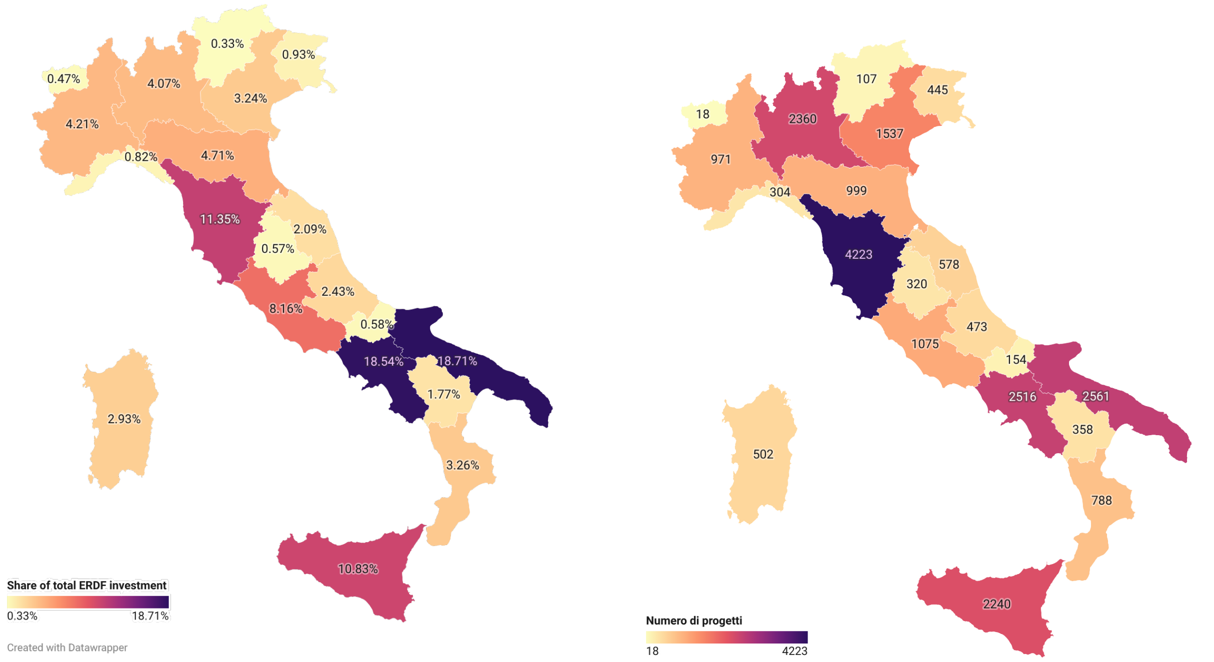
Figure 1.1: Total Funding towards different categories of beneficiaries: Relative total funding including European co-financed devolved by the European Regional Development Fund (ERDF) to the various categories of beneficiaries.



The European Social Fund (ESF) financing allocated to ”health-related” policies amounts to just over one billion euros in total, of which 790 million euros represent European co-financing. The territorial distribution of funds and projects (Table 1.3) essentially confirms what was observed for the ERDF. In this case as well, the region of Puglia stands out for a significant amount of resources allocated to education and training for children and older people, with over 299.5 million euros in total investment, of which 86.85%, equivalent to more than 260 million euros, comes from European Union contributions.

Looking at the number of projects (Figure 1.3b), Tuscany is in the lead with 1,983 projects, followed by Puglia with 386 projects and Lazio with 377 projects. In these regions, most of the projects were initiated by municipalities to finance service vouchers for non-self-sufficient individuals. This is an income support measure managed at the municipal level to assist financially disadvantaged individuals who are ill. Finally, a smaller portion of the funds was directed towards enhancing the training of personnel working in the regions.

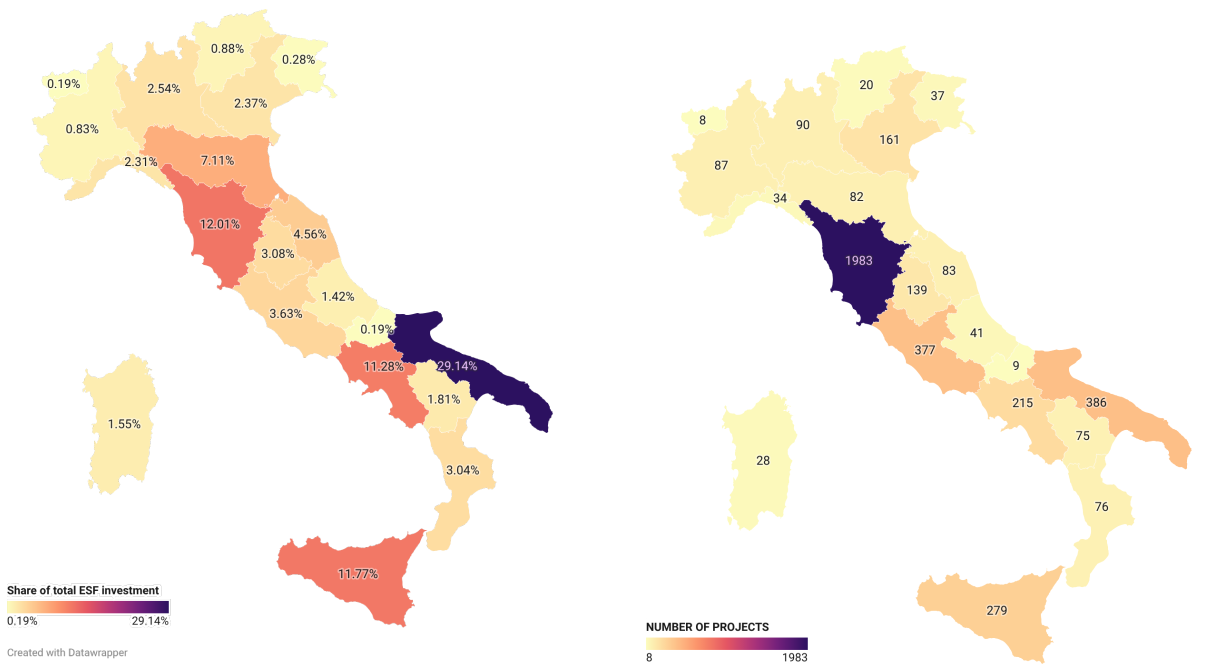
Figure 1.2: Regional distribution of ERDF investments and co-financed projects in Italy.



(a) Share of total ERDF investment by region (%)

(b) Number of projects co-financed by the ERDF

Figure 1.3: Regional distribution of ESF investments and co-financed projects in Italy.



(a) Share of total ESF investment by region (%)

(b) Number of projects co-financed by the ESF

Table 1.3: Total Funding towards different categories of beneficiaries: relative total funding including European co-financed devolved by the European Social Fund (ESF)

REGIONS	**Total Investment**	**EU Co-funded**	**EU co-funded/ Total investment (%)**
Abruzzo	14,643,590.96 €	4,076,779.33 €	27.84%
Basilicata	18,654,741.76 €	15,094,824.32 €	80.92%
Calabria	31,257,738.62 €	23,686,430.52 €	75.78%
Campania	115,933,816.04 €	89,022,255.25 €	76.79%
Emilia-Romagna	73,113,201.96 €	38,751,737.44 €	53.00%
Friuli-Venezia Giulia	2,895,148.38 €	1,763,429.78 €	60.91%
Lazio	37,308,379.18 €	20,806,036.86 €	55.77%
Liguria	23,748,197.84 €	15,544,150.35 €	65.45%
Lombardy	26,154,047.10 €	16,378,731.16 €	62.62%
Marche	46,855,504.45 €	23,958,642.44 €	51.13%
Molise	1,907,841.92 €	1,665,503.82 €	87.30%
Piedmont	8,482,269.05 €	5,267,414.42 €	62.10%
Apulia	299,500,703.80 €	260,105,562.19 €	86.85%
Sardinia	15,957,580.89 €	8,965,056.72 €	56.18%
Sicily	120,984,216.68 €	106,294,336.10 €	87.86%
Tuscany	123,405,291.16 €	121,584,079.05 €	98.52%
Trentino-Alto Adige	9,014,072.24 €	4,511,363.31 €	50.05%
Umbria	31,691,236.53 €	16,228,039.88 €	51.21%
Aosta Valley	1,994,087.31 €	997,043.66 €	50.00%
Veneto	24,339,123.28 €	15,309,249.14 €	62.90%
Total	**1,027,840,789.15 €**	**790,010,665.74 €**	**76.86%**

Source: author’s elaboration on OpenCoesione data (April 2023)

1.4 Structural Funds for COVID-19 Response

The 2014-2020 programming period unfortunately coincided with the COVID-19 pandemic emergency. As a result, a significant portion of the regional resources was used to address the crisis. According to the 2023 Annual Summary Report by the European Commission (European Commission, 2024), substantial efforts were made across Europe to mitigate the impact of COVID-19 using European funds (ERDF and ESF). In the Opencoesione database, there is a subsection dedicated to analyzing funds used to combat the COVID-19 emergency, utilizing European funds (ERDF and ESF). The total resources attributed to individual regions amount to 1.7 billion euros, to which additional funding from national projects and other projects that affected multiple regions should be added, bringing the overall amount to 3.2 billion euros. A substantial portion of these resources was also allocated to provide low-income families and workers with technological equipment (e.g., computers, tablets, etc.) to enable remote learning.

Looking at the territorial distribution (Table 1.4), it's evident that the majority of the resources were allocated to Campania (over 339 million euros with 571 projects), followed by Lazio (over 222 million euros with 446 projects), and Tuscany (over 213 million euros with 4093 projects). Puglia allocated resources from both the ERDF and ESF, totaling more than 204 million euros across 387 projects.

1.5 Discussion and Conclusion

As our analysis has attempted to highlight, European Union Structural Funds have been widely used to enhance regional healthcare through a range of targeted strategies and projects. These funds can be seen as an additional investment tool to finance the construction, renovation, or modernization of healthcare facilities such as hospitals, diagnostic centers, clinics, and long-term care facilities. Over the years, these resources have helped ensure that facilities are equipped with state-of-the-art equipment and technologies.

Table 1.4: Regions Funded by ERDF and ESF to counter the pandemic.

REGIONS	**Total Investment**	**EU Co-funded**	**EU co-funded/ Total investment (%)**
Abruzzo	51,650,533.76 €	35.016.402,67 €	67.79%
Basilicata	15,707,159.24 €	14,083,281.23 €	89.66%
Calabria	5,067,620.87 €	3,308,906.53 €	65.30%
Campania	339,596,236.01 €	246,944,320.47 €	72.72%
Emilia-Romagna	90,064,138.51 €	44,963,214.40 €	49.92%
Friuli-Venezia Giulia	2,261,897.91 €	1,667,547.25 €	73.72%
Lazio	222,615,461.76 €	211,657,943.75 €	95.08%
Liguria	10,315,189.94 €	5,619,594.17 €	54.48%
Lombardy	23,493,635.96 €	15,817,375.96 €	67.33%
Marche	28,126,935.91 €	14,868,138.30 €	52.86%
Molise	24,906,606.56 €	17,583,533.06 €	70.60%
Piedmont	136,599,950.18 €	69,750,352.73 €	51.06%
Apulia	204,810,318.84 €	182,814,605.88 €	89.26%
Sardinia	41,782,477.78 €	21,338,424.72 €	51.07%
Sicily	173,332,065.40 €	140,228,941.81 €	80.90%
Tuscany	213,795,539.70 €	145,281,239.96 €	67.95%
Trentino-Alto Adige	11,329,170.23 €	5,914,585.06 €	52.21%
Umbria	18,175,928.89 €	9,096,273.11 €	50.05%
Aosta Valley	9,089,670.40 €	4,470,615.33 €	49.18%
Veneto	96,997,770.74 €	44,773,771.58 €	46.16%
Total	**1,719,718,308.59 €**	**1,235,199,067.97 €**	**71.83%**

Source: author's elaboration on OpenCoesione data (April 2023)

The funds can finance medical research and technological innovation in the healthcare sector, fostering the development of cutting-edge diagnostic and therapeutic solutions. They can be used to implement disease prevention and health promotion programs at the regional level. This may include awareness campaigns, vaccination programs, and initiatives promoting a healthy lifestyle. The European Social Fund is a crucial tool for supporting care for non-self-sufficient individuals and represents a fundamental form of income support for less affluent families.

As we have emphasized, these funds can accompany substantial changes in healthcare and assistance processes, as seen in some regions where telemedicine and healthcare technologies have been implemented, enabling remote diagnosis and treatment and improving access to healthcare services, especially in remote areas. Structural funds have also been used to develop emergency preparedness and management programs for healthcare crises such as pandemics or natural disasters, enhancing the capacity of regional healthcare facilities to respond effectively to critical situations.

Our analysis found that EU funding allocated to ”health-related” projects during the 2014-2020 programming period amounted to just over 6.19 billion euros. This included 5.1 billion euros financed by the ERDF and just over 1 billion euros financed by the ESF. These funds supported a total of 26,739 projects, with 22,529 funded by the ERDF, primarily focusing on infrastructure projects and the acquisition of new technologies in the healthcare sector. Meanwhile, the 4,210 projects funded by the ESF were dedicated to personnel training and public health policies in the regions. The European co-financing provided by the ERDF exceeded 63%, while for the ESF, the European share was approximately 77%.

Regarding the recipients of ERDF funds, 17.19% of the total resources were allocated to municipalities, 18.11% to healthcare providers, and the remaining 64.70% to various other healthcare service providers, including private companies and educational institutions. The regional distribution of ERDF funds revealed significant heterogeneity, with Southern regions like Puglia and Campania receiving the highest investments. Puglia received over 983 million euros (79% financed by EU contributions), and Campania received over 974 million euros (68% from EU funding). Tuscany led in the number of projects with 4,223, followed by Puglia with 2,561 and Campania with 2,516.

For the ESF, the regional distribution also confirmed the prominence of regions like Puglia, which received significant resources for education and training for children and older persons, totaling over 299.5 million euros with 86.85% coming from EU contributions. Tuscany again led in the number of projects with 1,983, followed by Puglia with 386 and Lazio with 377.

Numerical comparisons from the European Structural and Investment Funds (Structural & Funds,

2020) data reveal that the EU's cohesion policy investments in health have been substantial. For example, the Coronavirus Response Investment Initiatives (CRII/CRII+) in 2020 increased health allocations to EUR 16.8 billion from over EUR 10 billion in 2019, demonstrating a significant rise in funding to support healthcare in response to the COVID-19 pandemic. The ERDF funded projects like the EUR 71 million investment in Bulgaria to improve emergency healthcare services, providing modern infrastructure and 400 new ambulances. Additionally, cross-border cooperation projects between Lithuania and Poland enhanced emergency response times and promoted the EU-wide 112 emergency number.

Our analysis suggests that European Structural Funds have supported the enhancement of regional healthcare systems through a range of targeted strategies and projects. The case of Slovakia, where ESIF investments resulted in measurable improvements in hospital readmission rates, underscores the potential of these funds to address specific healthcare challenges. However, as noted by Fidrmuc et al. (2022), the primary challenge remains the efficient use of available resources rather than the mere availability of funds. This aligns with broader findings in the literature that emphasize the need for systemic efficiency improvements to maximize the benefits of financial investments in healthcare.

In conclusion, regional analysis has shown significant heterogeneity in the use of funds and their distribution at the territorial level. The territorial distribution is greatly influenced by the ability of regional authorities to activate these resources through fundable projects. To address this, a coordinated approach and unified healthcare service development strategy should be pursued, requiring greater collaboration and coordination among the various Italian and European regions. In the coming years, the dissemination of best practices should be enhanced, allowing for learning from effective approaches adopted by other regions and their implementation at the local level. Furthermore, transnational projects should be strengthened to finance research projects, the development of networks of excellence, or training programs that could contribute to improving healthcare services and ensuring a more equitable distribution at the regional level. This approach could benefit not only wealthier regions but also deprived regions, promoting convergence not only in economic but also in healthcare terms.

Chapter 2

Business cycles and mortality in Italy

Our study examines the relationship between business cycles and mortality rates in Italy over the period 2004–2019. Using the unemployment rate as a proxy for macroeconomic conditions, we investigate how economic fluctuations affect mortality rates across causes of death, age groups, genders, and educational levels. The analysis relies on data from the National Institute of Statistics (ISTAT) and applies panel data methods to control for province-specific heterogeneity and time effects. The findings reveal a procyclical pattern, with higher unemployment rates associated with lower mortality. Substantial heterogeneity emerges across demographic groups and causes of death. To test robustness, the analysis is extended to include the COVID-19 pandemic years (2020–2021), thereby assessing its impact on the previously identified relationships. Results suggest that the pandemic disrupted established unemployment–mortality dynamics, particularly for transport accidents and respiratory diseases. Overall, the findings highlight the importance of targeted public policies to mitigate health risks during economic expansions and provide insights into how macroeconomic conditions shape public health outcomes in Italy.

Keywords: Business Cycles • Mortality Rates • Unemployment • Public Health • Italy • Regional Disparities • COVID-19 Impact

JEL Classification: E32 • I10 • I12 • I14 • J14 • J16

2.1 Introduction

The association between macroeconomic conditions and health outcomes has received considerable research attention, as it encompasses critical socio-economic and psychological dimensions. In Italy, a country characterized by pronounced regional economic disparities and a rapidly aging population, this relation remains relatively underexplored. This study investigates the link between business cycles—particularly fluctuations in unemployment—and mortality rates in Italy over the period 2004–2019, thereby addressing a notable gap in the existing literature.

Traditionally, economic downturns have been considered particularly detrimental, especially for individuals with limited economic resources. The conventional paradigm regarding the health effects of macroeconomic fluctuations posits that recessions exert disproportionately adverse impacts on the most vulnerable segments of the population (Brenner, 1971, 1975, 1979). Nevertheless, an expanding body of evidence has challenged this view, particularly in developed countries with functional social safety nets. Several studies have documented a procyclical pattern, whereby mortality increases during periods of economic expansion, notably in the United States (Brenner, 1979; Ruhm, 2000) and Spain (Cervini-Plá & Vall-Castelló, 2021). Subsequent research suggests that, although mortality has historically followed a procyclical trajectory, the strength of this association has attenuated over time in certain contexts, likely reflecting changes in health behaviors and public policy interventions (Ruhm, 2015).

Stuckler et al. (2009), in their analysis of European countries, emphasized that economic crises may induce substantial deterioration in public health, particularly in contexts characterized by reductions in healthcare expenditure. Collectively, these findings underscore the complexity and heterogeneity inherent in the macroeconomic–health association across diverse demographic and geographic contexts.

Moreover, unemployment has been identified as a critical determinant of health outcomes. Sullivan and Von Wachter (2009) demonstrated that job loss is associated with elevated mortality rates in both the short and long term, highlighting the substantial health risks faced by affected individuals. These findings reinforce the importance of robust social safety nets and targeted public health interventions during periods of economic contraction. Complementary evidence from Browning and Heinesen (2012) revealed that job displacement resulting from plant closures in Denmark led to significant increases in both mortality and hospitalizations, with effects persisting over several years.

Expanding the scope to early-life outcomes, Dehejia and Lleras-Muney (2004) investigated the influence of business cycles on neonatal health in the United States. The study found that children born during recessions exhibited improved health outcomes, including lower rates of low birth weight and infant mortality. This evidence introduces a new dimension to the literature, indicating that the effects of macroeconomic fluctuations on health may commence as early as birth.

Furthermore, prior research has demonstrated that economic downturns may differentially affect specific causes of death, with transport accidents and respiratory diseases showing the most pronounced sensitivity to unemployment fluctuations (Ruhm, 2000; Gerdtham & Ruhm, 2006). Collectively, these studies highlight the nuanced and multifaceted nature of the macroeconomic–health nexus, suggesting that the effects of business cycles are contingent upon age, cause of death, and socio-economic context.

This paper addresses the research gap by providing a comprehensive analysis of the Italian context, exploring variations in mortality across causes of death, demographic groups, and regions. Using provincial-level data and panel methodologies, we examine the association between business cycles and mortality in Italy over the period 2004–2019.

Compared to the extensive literature on other countries, studies focusing specifically on Italy remain scarce, particularly at the regional level (one exception is Cavicchioli & Pistoresi, 2020). Italy's unique demographic and economic characteristics—such as its pronounced North–South economic divide, historically high unemployment rates, and aging population—render it an especially compelling case for examining the interplay between economic conditions and public health. These structural disparities create a distinctive context in which to analyze how economic cycles influence mortality. Moreover, Italy has experienced several major economic crises, including the sovereign debt crisis of 2011–2013, which significantly affected the labor market and may have had substantial implications for public health. Investigating these periods provides valuable insights into the ways economic downturns affect mortality in a country characterized by a robust welfare system yet marked by persistent structural inequalities.

Consistent with prior studies, the analysis is disaggregated by age, gender, and education level, as well as by cause of death, using national vital statistics at the provincial level. To assess robustness, the analysis is extended to include 2020 and 2021, thereby evaluating the impact of COVID-19 on the unemployment–mortality association.

In this study, the unemployment rate serves as a key indicator of macroeconomic conditions, reflecting both the state of the labor market and broader economic performance. This variable typically fluctuates with economic cycles, rising during recessions and declining during periods of recovery and expansion. Beyond functioning as a marker of economic performance, unemployment has profound implications for both physical and mental health. Understanding the mechanisms through which unemployment affects health is essential for designing effective policies to mitigate its adverse impacts.

Figure A4 in the appendix illustrates trends in unemployment and mortality rates from 2004 to 2019. The unemployment rate is depicted by the blue line, while the mortality rate is represented by the orange line. From 2004 to 2011, both rates remain relatively stable. However, beginning around 2011–2012, the unemployment rate rises sharply, coinciding with the sovereign debt crisis. This increase peaks between 2013 and 2014 before gradually declining. In contrast, the mortality rate remains largely flat for most of the period, showing a slight upward trend from approximately 2015 onward. Notably, during the peak unemployment years (2013–2014), the mortality rate does not exhibit a corresponding spike, suggesting a potential decoupling between economic downturns and immediate changes in mortality.

Similarly, Table A7 in the appendix supports the analysis of potential relationships between unemployment and mortality. During periods of elevated unemployment (2008–2011), no immediate or clear increase in mortality is observed, indicating that the unemployment–mortality relationship is complex and not straightforward.

In line with prior studies, we observe a procyclical pattern: increases in unemployment correlate with decreases in mortality. The effect is more pronounced for men than for women, for whom the relationship is not statistically significant. Moreover, the impact varies across causes of death. Across age groups, effects are generally not statistically significant, except for the 16–24 cohort, which shows statistically significant procyclical coefficients. By education level, individuals with higher attainment—high school and university graduates—also exhibit a significant procyclical pattern. Incorporating data from the COVID-19 pandemic (2020–2021) indicates that this global health crisis has altered established unemployment–mortality dynamics, attenuating the previously observed negative association. Notably, deaths from respiratory diseases exhibit a countercyclical pattern over this period, whereas all other causes with statistically significant coefficients remain procyclical.

The findings of this study carry important implications for economic and health policy formulation in Italy, both during periods of recession and expansion. By identifying the dynamics between unemployment and mortality, the study can guide policymakers in implementing effective preventive measures to protect vulnerable populations.

It is important to emphasize that this paper does not aim to establish causal relationships; rather, it provides a descriptive analysis intended to facilitate cross-country comparisons. While certain causes of death, such as transport accidents, are well-established in the literature as directly influenced by unemployment fluctuations, others, such as cancer-related mortality, may be affected by additional factors and prior conditions. This distinction highlights the complexity of the unemployment–mortality association across different causes of death.

The paper is structured as follows: Section 2.2 introduces the data and descriptive statistics, detailing the dataset and sample selection process. Section 2.3 outlines the methodology employed. Section 2.4 presents the main results, highlighting key findings. Section 2.5 examines heterogeneous effects, analyzing variations across gender and age groups. Section 2.6 provides robustness checks, incorporating data from 2020 and 2021 to assess the impact of COVID-19. Finally, Section 2.7 concludes by summarizing the main insights and contributions of the study.

2.2 Data and Descriptive Statistics

We use data from the National Institute of Statistics (ISTAT), Italy's official agency for collecting and disseminating economic, demographic, social, and health statistics. The dataset contains detailed information on mortality and unemployment rates.

The dependent variable is the mortality rate between 2004 and 2019 at the provincial level. Individual-level records include causes of death and demographic characteristics such as sex, age, and education, which we aggregated by province and year. The sample covers 103 of Italy's 107 provinces, excluding four created after 2009.[1]

The analysis focuses on individuals aged 15–74, the only age group for which consistent provincial-level data are available. This range encompasses most of the working-age population and is therefore suitable for studying the interaction between labor market conditions and health outcomes.

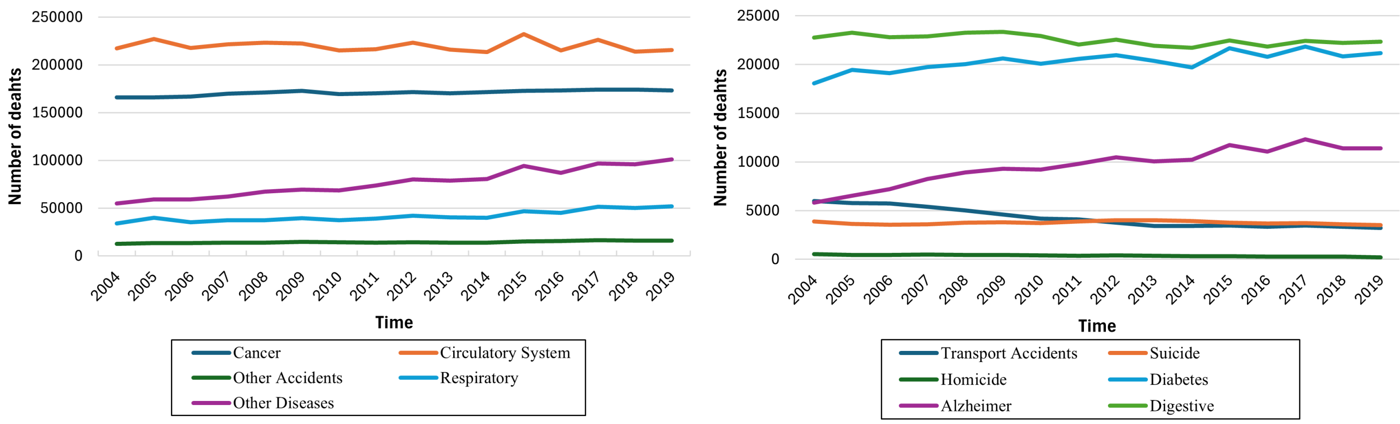
[1] Barletta-Andria-Trani, Fermo, and Monza and Brianza were established in 2009, and South Sardinia in 2016.

As mentioned earlier, we aggregated individual-level data by province and year to calculate the number of deaths in each province during the study period. Additionally, we collapse the data by cause of death. The selection of these causes was based on their significance as primary statistical indicators for assessing a population's health status and addressing the healthcare planning needs of the country. Specifically, we included the following categories: *Transport accidents*, *Suicide*, *Homicide*, *Cancer*, *Diabetes*, *Alzheimer's disease*, *Circulatory system diseases*, *Digestive diseases*, *Respiratory diseases*, and *Other accidents* (including drowning, poisoning, events of undetermined intent, and other external causes of trauma and poisoning). We also included *Other diseases*, encompassing certain infectious and parasitic diseases, diseases of the blood and hematopoietic organs, immune system disorders, endocrine, nutritional, and metabolic diseases, mental and behavioral disorders, diseases of the nervous system and sense organs, among others.

Figure 2.1 shows mortality trends by cause between 2004 and 2019. The left panel shows a relatively stable trend in cancer-related deaths, a slight increase in respiratory disease mortality, and a consistent number of deaths from other accidents. There is also a modest upward trend in deaths from circulatory system diseases and a notable rise in deaths from other diseases, particularly after 2015. In the right panel, a continuous decline in deaths from transport accidents is evident throughout the period. Suicide-related deaths show a slight decrease over time, while homicide-related deaths remain relatively low and stable. Mortality from digestive diseases remains constant, whereas deaths from Alzheimer's disease exhibit an increasing trend, particularly after 2010, reflecting the impact of an aging population. Lastly, deaths due to diabetes show a slight upward trend.

The unemployment rate is used as a macroeconomic indicator to capture business cycle fluctuations. This choice is based on evidence that other economic indicators, as highlighted by Granados (2005), are highly correlated. Such correlations can lead to unreliable results in multiple regressions when modeling mortality using two or more economic indicators simultaneously. Notably,

Figure 2.1: Evolution of mortality by cause in the period 2004-2019 - Source: ISTAT



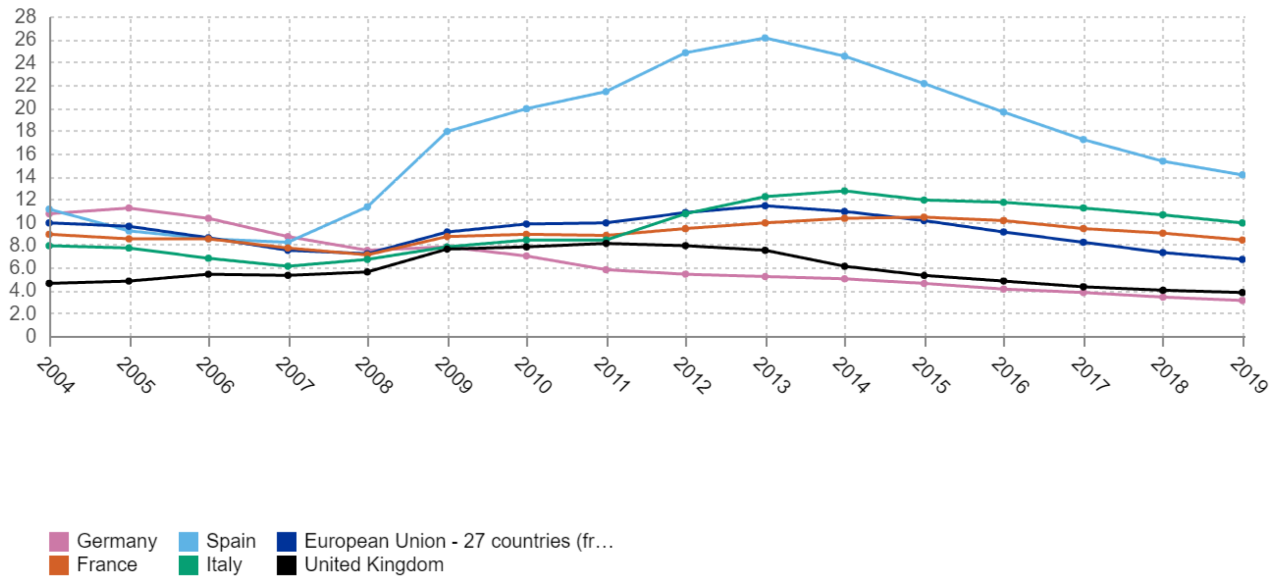
Source: author's elaboration on ISTAT data.

when mortality is regressed on multiple economic variables, unemployment is the only variable that consistently remains statistically significant. Furthermore, previous research has shown that the effects of regional GDP or income are more sensitive to model specifications compared to the effects of regional unemployment, reinforcing the robustness of unemployment as an indicator of health fluctuations (Ruhm (2000); Granados (2005)). Finally, the choice of the unemployment rate is also motivated by its practicality for provincial-level analysis, given the challenges associated with obtaining GDP data at such a granular level.

Figure 2.2 illustrates unemployment trends in Italy relative to the EU average. Until 2013, Italy's unemployment rate remained below the European average. The sovereign debt crisis of 2011–2012 triggered a sharp increase, from 8.4% in 2011 to 10.7% in 2012, peaking at 12.7% in 2014. As noted by Petrelli (2013), the rise was most pronounced in southern Italy, where unemployment reached 20.7% in 2014.

To capture heterogeneity in the relationship between economic conditions and mortality, we disaggregate by gender, age, cause of death, and education. Table A8 reports descriptive statistics. Men accounted for 48.54% of deaths (4,657,266) and women for 51.46% (4,937,313). Circulatory diseases were the leading cause of death (37.45%; 3,596,104), followed by cancer (29.19%; 2,800,617) and respiratory diseases (12.45%; 1,195,677).

Figure 2.2: Unemployment rate in Europe and forest selected countries (2004-2021)



Source: author's elaboration on Eurostat data.

By age, 72.84% of deaths (6,933,782) occurred among individuals aged 75 and older, and 14.74% (1,407,276) among those aged 65–74. Regarding education, 73.92% (7,050,636) of the deceased had only an elementary school certificate, 12.34% (1,176,601) a high school diploma, 11.68% (1,114,512) a middle school diploma, and just 2.64% (252,293) held a university degree.

2.3 Methodology

To examine the relationship between mortality and unemployment, we estimate the following specification, adapted from Cervini-Plá and Vall-Castelló (2021) and Ruhm (2015):

$$ln(M_{kjt}) = \alpha_{kj} + U_{jt}\gamma + \lambda_{kt} + H_j * T + A15\delta + A65\theta + \epsilon_{kjt} \tag{2.1}$$

where M_{kjt} denotes the mortality rate from cause k in province j at time t, and U_{jt} is the provincial unemployment rate at that time, used as a proxy for macroeconomic conditions. Mortality is defined as the number of deaths from a specific cause (or from all causes) relative to the provincial population, expressed per 1,000 inhabitants. In other words, the mortality rate measures the frequency of deaths within a population, adjusted for population size, and is calculated using the following formula:

$$M_{kjt} = \frac{\textit{Number of deaths}_{kjt}}{Population_{jt}/1000}$$

The term α captures province fixed effects, λ accounts for year effects, and ϵ is the error term. The parameter of interest, γ, measures the association between unemployment and mortality.

A log-linear form is employed so that coefficients can be interpreted as elasticities, i.e., the percentage change in mortality associated with a one percent change in unemployment. Year effects (λ_{kt}) absorb factors evolving uniformly across provinces, such as medical advances or changes in social behavior, while province fixed effects (α_{kj}) capture time-invariant local characteristics, such as lifestyle or environmental conditions. Thus, identification comes from within-province variation in unemployment relative to other provinces.

The specification also includes province-specific linear trends (H_jT), where T is normalized between zero (2004) and one (2019), following Ruhm (2015). This generates 103 province-specific time trends.

Demographic structure is controlled for using the share of the population aged under 15 (A_{15}) and over 65 (A_{65}), which account for variations in age composition and its potential effect on labor supply and health outcomes.

Equation 2.1 is estimated for overall mortality as well as by cause of death, using annual provincial data. We also explore heterogeneous effects by sex, five age groups (0–24, 25–44, 45–64, 65–74, 75+), and four educational levels (primary, secondary, high school, and university).

Finally, to quantify effect sizes, we follow Ruhm (2015) and Cervini-Plá and Vall-Castelló (2021). The relative effect of a one percentage point increase in unemployment on mortality from cause

k is:

$$(e^{\gamma_k} - 1) * 100\%$$

This formula provides the expected percentage change in mortality from cause k resulting from a one percentage point increase in the unemployment rate. These relative effects are then translated into absolute numbers using the formula:

$$(e^{\gamma_k} - 1) * \pi_k D$$

where π_k represents the share of deaths attributable to cause k and D is the average annual number of deaths (599,661).

2.4 Results

We begin by analyzing the relationship between unemployment and total mortality, with attention to differences across causes of death.

The first row of Table 2.1 shows that overall mortality ("All Causes") is procyclical. The coefficient (-0.00161) is negative and statistically significant, indicating that a one–percentage point increase in the local unemployment rate is associated with a modest decline (-0.16%) in mortality. This finding supports the view that overall mortality follows a procyclical pattern, consistent with Ruhm (2015), who reported a weakening of this relationship over time.

Focusing on the statistically significant coefficients, the analysis reveals a nuanced pattern across causes of death. Specifically, a one percentage point increase in the unemployment rate is associated with a 0.853% decrease in the mortality rate from transport accidents, which is statistically significant at the 90% confidence level. Similarly, a one percentage point increase in the unem-

Table 2.1: Association between unemployment rate increase and mortality rate by cause of death

Mortality Rate	Unemployment Rate
All Causes	-0.00161*
	(0.000923)
Transport Accidents	-0.00853*
	(0.00471)
Suicide	-0.00916*
	(0.00503)
Homicide	0.00282
	(0.0116)
Cancer	-0.00139
	(0.00102)
Diabetes	-0.000960
	(0.00227)
Alzheimer	-0.00258
	(0.00335)
Circulatory System Diseases	-0.00192*
	(0.00111)
Digestive	-0.000923
	(0.00192)
Other Accidents	-0.000761
	(0.00264)
Respiratory	-0.00270
	(0.00169)
Other Diseases	-0.00122
	(0.00147)
Observations	1,648
Year fixed effects	YES
Province fixed effects	YES
Province specific linear trends	YES

All estimations include Year FE, Province FE,
Linear trends and Demographic control.
Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

ployment rate corresponds to a 0.916% decrease in the suicide rate, also significant at the 90% confidence level. In the same vein, a one–percentage-point increase in the unemployment rate is associated with a 0.192% decrease in mortality from circulatory system diseases, significant at the 90% confidence level.

The decline in mortality from transport accidents aligns with the hypothesis that economic downturns reduce mobility and traffic volumes, leading to fewer fatal accidents, consistent with the mechanisms discussed by Ruhm (2000) and further examined by Cervini-Plá and Vall-Castelló (2021) for the Spanish context.

For other causes, coefficients are not statistically different from zero. In particular, cancer and diabetes show negative but insignificant associations, while homicide is positive but insignificant. Remaining categories ("Respiratory," "Digestive," "Other Accidents," "Alzheimer's," and "Other Diseases") also yield negative yet insignificant estimates.

Overall, these results suggest predominantly procyclical dynamics for certain external and cardiovascular causes. Mortality from transport accidents declines notably during downturns, consistent with reduced exposure to mobility-related risks. The suicide effect is modest (10% significance) and should be interpreted with caution, but it contributes to the procyclical pattern observed in the data.

While the findings partially align with Cervini-Plá and Vall-Castelló (2021) for Spain, indicating procyclical patterns in mortality for certain causes, the lack of procyclicality every causes of mortality mirrors the trends identified by Ruhm (2015). Specifically, Ruhm documented a decline in the procyclicality of overall mortality over time. His analysis highlighted a substantial shift in the relationship between macroeconomic conditions and mortality: total deaths transitioned from being strongly procyclical in the 1970s and 1980s to largely uncorrelated with macroeconomic fluctuations in the early 21st century.

It is important to emphasize that the absence of a clear aggregate relationship does not imply that job loss leads to improved health outcomes. On the contrary, our results align with the evidence presented by Sullivan and Von Wachter (2009), who demonstrate that unemployment significantly increases mortality risk, both in the medium and long term, due to acute and chronic stress, reduced financial resources, and employment instability.

This apparent paradox is further discussed by Tapia Granados et al. (2014), who reveal that while individual unemployment increases mortality risk, higher contextual (state-level) unemployment rates are associated with reduced mortality at the aggregate level. Given that our analysis is conducted at the macro level using provincial data rather than individual-level observations, our findings are more consistent with the contextual component of this paradox. Specifically, although individual job loss remains profoundly detrimental to health, higher unemployment at the aggregate level may coincide with reductions in specific types of mortality due to lower exposure to certain risks during recessions, while leaving overall mortality largely unaffected.

2.5 Heterogeneous Analysis

In this section, we explore heterogeneities by examining the association between unemployment and mortality across age groups, gender, and educational levels. All specifications include year and province fixed effects as well as demographic controls, thereby accounting for unobserved variations specific to a given year or province and reducing the risk of omitted-variable bias.

Table 2.2 reports the relationship between fluctuations in unemployment and mortality across different age groups. The results highlight substantial heterogeneity by age.

Only the 16–24 age group exhibits a statistically significant association: a 1% increase in the unemployment rate corresponds to a 0.194% decline in mortality. This procyclical pattern appears specific to younger cohorts; for the other age groups, coefficients remain negative (procyclical) but are not statistically significant. A plausible explanation lies in age-specific causes of death. Among young individuals, traffic accidents represent a leading cause of mortality, and prior research shows that road fatalities are highly procyclical. For example, Stevens et al. (2015) document that increases in unemployment are associated with marked declines in traffic-related deaths among young adults, while He (2016) find that each percentage-point increase in unemployment reduced motor vehicle fatalities by 2.9% in the U.S. during the Great Recession. These reductions are not primarily driven by fewer miles traveled but by lower risk per mile, particularly in crashes involving heavy trucks, multi-vehicle collisions, and speeding. During downturns, reduced commercial activity lowers truck circulation and congestion, while risky behaviors such as speeding or alcohol-impaired driving decline due to reduced disposable income. Taken together, this evidence suggests that the significant mortality decline observed among the 16–24 age group during recessions is largely explained by reductions in road traffic fatalities, a cause to which young people are disproportionately exposed.

Table 2.2: Changes in age-specific mortality rates relative to unemployment rate fluctuations

Mortality Rate	16-24	25-44	45-64	65-74	75+
Unemployment rate	-0.194***	-0.022	-0.020	-0.009	-0.005
	(0.022)	(0.016)	(0.016)	(0.016)	(0.016)
Observations	1646	1648	1648	1648	1648
R^2	0.987	0.987	0.987	0.987	0.987
Year fixed effects	YES	YES	YES	YES	YES
Province fixed effects	YES	YES	YES	YES	YES
Province specific linear trends	YES	YES	YES	YES	YES

All estimations include Year FE and Province FE.
Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Previous studies have shown that macroeconomic conditions, including unemployment, can influence mortality, but effects often differ substantially between men and women (Gerdtham & Johannesson, 2005). As a second dimension of heterogeneity, we examine the association by gender. Table 2.3 presents the results, highlighting important differences across causes of death.

For men, the coefficient for "All Causes" is negative and marginally significant ($\rho < 0.10$), suggesting modest procyclicality: a one–percentage-point increase in unemployment is associated with a 0.17% decline in overall mortality. Cause-specific estimates reveal further procyclical effects. Mortality from suicide, other accidents, and respiratory diseases falls significantly when unemployment rises: a one–percentage-point increase in unemployment is associated with 0.97% fewer suicide deaths (significant at the 10% level), 0.68% fewer deaths from other accidents (significant at the 5% level), and 0.39% fewer respiratory deaths (significant at the 10% level). While the suicide result may appear counterintuitive, these patterns are consistent with reduced work- and traffic-related exposures during downturns and with more time available for health maintenance. In contrast, estimates for homicide, circulatory diseases, digestive diseases, Alzheimer's, transport accidents, cancer, and other causes are not statistically significant. Overall, men's mortality displays modest procyclicality, driven mainly by reductions in external and respiratory causes, while most other outcomes show no systematic association with unemployment.

For women, the coefficient for "All Causes" is negative but not statistically significant, indicating no aggregate relationship between unemployment and mortality. At the cause-specific level, however, distinct patterns emerge. Transport accidents decline as unemployment rises (1.33% per one–percentage-point increase, 5% level), consistent with lower mobility and reduced exposure to traffic during recessions. Homicide also decreases (2.03% at 5% level), suggesting a procyclical pattern potentially linked to reduced public or contact-intensive activities in weaker labor markets. By contrast, deaths from other accidents increase (0.46% at 5% level), pointing to a countercyclical component that may reflect greater time spent at home and a higher incidence of domestic accidents. For suicide, cancer, diabetes, Alzheimer's, circulatory, digestive, respiratory, and other causes, no statistically significant effects are observed.

Table 2.3: Relationship between unemployment rate changes and mortality for different causes of death by gender

Mortality Rate	Men	Women
All Causes	-0.00170*	-0.000357
	(0.00101)	(0.000644)
Transport Accidents	-0.00613	-0.0133**
	(0.00475)	(0.00660)
Suicide	-0.00969*	0.00158
	(0.00523)	(0.00698)
Homicide	-0.00161	-0.0203**
	(0.0123)	(0.00975)
Cancer	-0.00178	-0.000600
	(0.00117)	(0.000867)
Diabetes	0.00200	-0.000153
	(0.00307)	(0.00186)
Alzheimer	-0.00373	-0.0000843
	(0.00536)	(0.00267)
Circulatory System Diseases	-0.00110	-0.000531
	(0.00130)	(0.000768)
Digestive	-0.00170	0.00144
	(0.00240)	(0.00191)
Other Accidents	-0.00678**	0.00459**
	(0.00337)	(0.00225)
Respiratory	-0.00387*	-0.00101
	(0.00202)	(0.00160)
Other Diseases	-0.00230	-0.000141
	(0.00176)	(0.00114)
Observations	1,648	1,648
Year fixed effects	YES	YES
Province fixed effects	YES	YES
Province specific linear trends	YES	YES

All estimations include Year FE, Province FE
and demographic control.
Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.4 presents the relationship between unemployment and mortality across education groups. The coefficients for individuals with high school and university education are negative and statistically significant, indicating procyclicality, consistent with the findings of Edwards (2008). For those with a high school degree, a one–percentage-point increase in unemployment is associated with a 0.694% reduction in mortality, while for university graduates the reduction is 0.628%. These effects may reflect better access to healthcare, healthier lifestyles during unemployment, greater adaptability to economic hardship, and more generous unemployment benefits, all of which may mitigate mortality risk during downturns.

Table 2.4: Relationship between unemployment rate changes and mortality for different cause of death by education level

Mortality Rate	Primary	Secondary	High School	University
Unemployment Rate	-0.00174	0.000380	-0.00694**	-0.00628**
	(0.00116)	(0.00287)	(0.00267)	(0.00299)
Observations	1648	1648	1648	1648
R^2	0.9175	0.8920	0.9162	0.8363
Year fixed effects	YES	YES	YES	YES
Province fixed effects	YES	YES	YES	YES
Province specific linear trends	YES	YES	YES	YES

All estimations include Year FE, Province FE and Demographic control.
Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

These results partly align with Muller (2002), who found that the share of individuals without a high school diploma is positively and linearly associated with age-adjusted mortality. In our case, having at least a high school diploma appears protective against mortality during economic downturns.

Finally, we conclude this section by calculating the impact of these coefficients in terms of the number of deaths. Table 2.5 shows that a one percentage point increase in the unemployment rate leads to an average reduction of 965 deaths per year, with a 95% confidence interval ranging from -2407 to 119 deaths. When broken down by gender, the effect of a one percentage point increase

Table 2.5: Predictions of the number of deaths and confidence intervals at 95% for various causes of death.

Causes	Number of deaths	95% Conf. Interval	
Total Causes	-965	-2407	119
Transport accidents	-39	-81	3
Suicide	-36	-74	3
Circulatory System Diseases	-431	-919	57
Men	-494	-1069	81
Women	-110	-499	279

Note: In order to calculate the predicted number of death we use $(e^{\hat{\gamma}k} - 1)x\pi_k D$ where π_k is the share of deaths due to source k and D is the average annual number of deaths (599,661). 95% confidence intervals are estimated as $(e^{\hat{\gamma}k \pm 1.96 x s_k} - 1)x\pi_k D$ for s_k standard error. *** p<0.01, ** p<0.05.

in the unemployment rate is more pronounced for men, reducing deaths by 494, compared to a reduction of 110 deaths for women, the latter of which is not statistically significant.

We calculate death predictions for the causes of death that were statistically significant in the previous analysis, as shown in Table 2.1. Specifically, cardiovascular deaths show the largest decrease during a recession: a one percentage point increase in the unemployment rate leads to 431 fewer cardiovascular deaths annually. Additionally, a one percentage point rise in the unemployment rate is associated with a reduction of 39 deaths from transport accidents and 36 fewer deaths from suicide.

2.6 Robustness Check

In this section, we extend the analysis to 2020 and 2021 to examine the impact of the COVID-19 pandemic. Including these years allows us to assess whether the unemployment–mortality relationship changes significantly during this unprecedented crisis. The pandemic affected not only the healthcare system but also individual behaviors and lifestyles, influencing both direct and indirect causes of mortality. This extended timeframe therefore provides a more comprehensive perspective on the interplay between unemployment and mortality under extraordinary circumstances.

In the main analysis, we exclude the pandemic years because the pandemic represents an external factor that influences mortality (particularly by increasing deaths from respiratory causes) while simultaneously driving up unemployment due to the accompanying economic crisis. Consequently, during these years, both unemployment and mortality increase simultaneously, moving in the same direction. Therefore, our hypothesis is that when we include these years in the analysis, the relationship between unemployment and mortality will become less procyclical, as the dynamics observed during the pandemic are countercyclical in nature.

The data analysis in Table 2.6 indicates that the effect of unemployment on overall mortality is negative for both periods considered, suggesting that an increase in the unemployment rate generally corresponds to a decrease in mortality. However, the effect size is slightly smaller when the COVID-19 years are included, and the coefficient becomes statistically insignificant. This outcome can be explained by the contrasting effects observed across different causes of death. The pandemic caused a sharp rise in respiratory-related deaths, primarily due to COVID-19, as shown by the significant peak in respiratory mortality in 2020 (purple line in Figure 2.3). This trend is reflected in the positive and significant coefficient for respiratory diseases, highlighting the substantial impact of the pandemic on mortality specifically related to respiratory causes. In particular, with a one percentage point increase in the unemployment rate, respiratory disease mortality will increase by 0.39%. Furthermore, since the coefficient is positive and statistically significant at the 90% confidence level, it also indicates a countercyclical effect of the mortality rate with increasing unemployment.

At the same time, other causes of death remained stable or even declined. For example, deaths from transport accidents and cardiovascular diseases either decreased or did not increase significantly, likely due to mobility restrictions and lockdowns, which reduced incidents associated with external risks. This offset between the rise in respiratory-related deaths and the decline or stability in other causes contributed to maintaining a relatively stable overall mortality rate. Consequently,

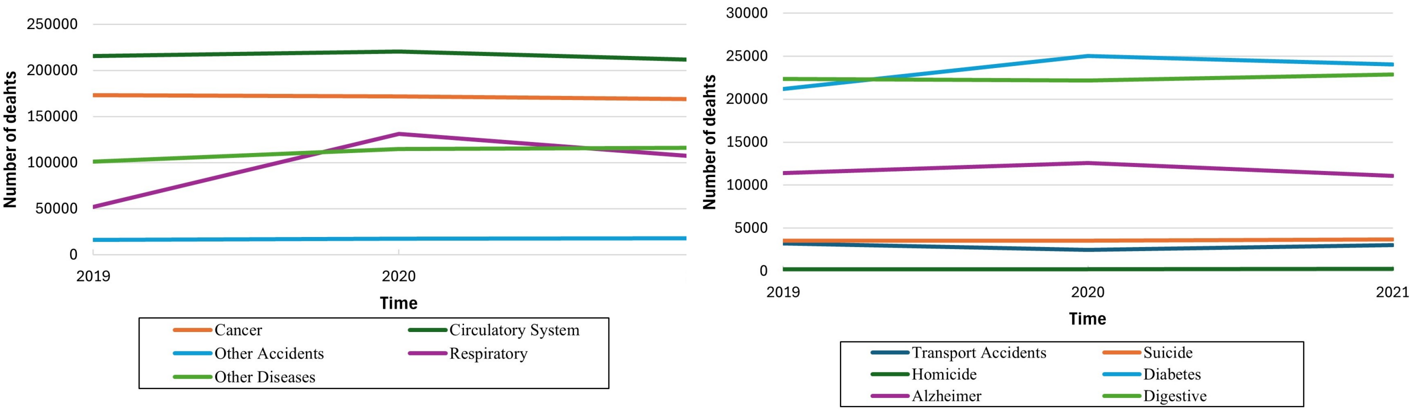
Table 2.6: Effect of a one point increase in the unemployment rate on the mortality rate due to different causes of death

Mortality Rate	2004-2019	2004-2021
All Causes	-0.00161*	-0.000618
	(0.000923)	(0.000854)
Transport Accidents	-0.00853*	-0.0107**
	(0.00471)	(0.00429)
Suicide	-0.00916*	-0.00197
	(0.00503)	(0.00431)
Homicide	0.00282	0.00893
	(0.0116)	(0.0101)
Cancer	-0.00139	-0.00165*
	(0.00102)	(0.000858)
Diabetes	-0.000960	-0.000204
	(0.00227)	(0.00197)
Alzheimer	-0.00258	-0.00442
	(0.00335)	(0.00310)
Circulatory System Diseases	-0.00192*	-0.00140
	(0.00111)	(0.000993)
Digestive	-0.000923	-0.00209
	(0.00192)	(0.00169)
Other Accidents	-0.000761	0.000608
	(0.00264)	(0.00225)
Respiratory	-0.00270	0.00388*
	(0.00169)	(0.00210)
Other Diseases	-0.00122	-0.00282**
	(0.00147)	(0.00130)
Men	-0.00170*	-0.00061
	(0.00101)	(0.00093)
Women	-0.00036	-0.00006
	(0.00064)	(0.00063)
Observations	1,648	1,854
Year fixed effects	YES	YES
Province fixed effects	YES	YES
Province specific linear trends	YES	YES

All estimations include Year FE, Province FE
and Demographic control.
Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

while unemployment increased and respiratory-related deaths rose during the pandemic, the stability in other causes resulted in no significant change in the total mortality rate.

Figure 2.3: Evolution of mortality by cause in the period 2019-2021



Source: author's elaboration on ISTAT data.

For "other diseases," the coefficient becomes negative and statistically significant at the 95% level once 2020–2021 are included. A one–percentage-point increase in unemployment is associated with a 0.28% reduction in mortality from these causes, consistent with procyclicality.

Overall, incorporating the pandemic years reduces the overall procyclical effect of unemployment on mortality. The most striking change concerns respiratory diseases, where the pandemic reversed the usual relationship, producing a countercyclical pattern. For other causes, procyclical effects persist, but they are overshadowed by the pandemic's direct impact on respiratory mortality.

2.7 Conclusion

This study analyzes the relationship between economic cycles and mortality in Italy from 2004 to 2019, using unemployment as an indicator of macroeconomic conditions. The results reveal a procyclical pattern: higher unemployment is associated with lower mortality, with notable variations by gender and cause of death. Comparable evidence of procyclical mortality has been documented in Germany Neumayer, 2004, Spain Cervini-Plá & Vall-Castelló, 2021; Granados, 2005, France Buchmueller et al., 2007, Mexico Gonzalez & Quast, 2011, Canada Ariizumi & Schirle, 2012, OECD countries Gerdtham & Ruhm, 2006, and Pacific-Asian nations Lin, 2009. When the pandemic years (2020–2021) are included, the relationship weakens, with the effect of unemployment on mortality becoming negative but statistically insignificant.

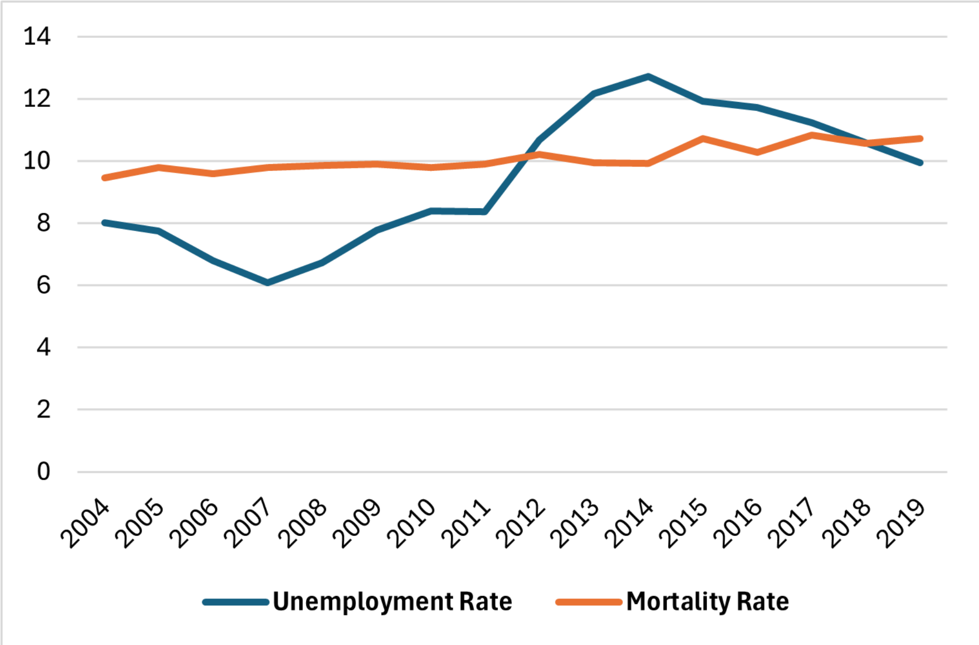
The gender-specific analysis shows that unemployment significantly reduces mortality among men, but the effect is not significant for women. The impact also differs across causes of death: mortality from road accidents, suicides, and cardiovascular diseases declines when unemployment rises, while respiratory-related deaths increase during the pandemic, reflecting the influence of COVID-19. Across age groups, only the 16–24 cohort exhibits a statistically significant (procyclical) decline in mortality; estimates for other age groups are negative but not significant. Moreover, educational disparities are marked: the procyclical effect is strongest among individuals with higher education, such as high school and university graduates.

This study contributes to the literature by providing a provincial-level analysis for Italy, thereby emphasizing the importance of demographic characteristics in assessing the health effects of economic conditions. This approach complements the national-level time series analysis of Cavicchioli and Pistoresi (2020).

In sum, the evidence confirms a general procyclical relationship between unemployment and mortality, while the pandemic years illustrate how extraordinary crises can alter these dynamics. The findings underscore important policy implications: the health consequences of job loss extend beyond immediate economic hardship. Targeted interventions for unemployed individuals could therefore improve not only economic outcomes but also reduce health risks associated with labor market shocks. At the same time, periods of economic expansion and low unemployment also require careful monitoring, as they are associated with higher risks of traffic accidents and stress-related conditions. Policies aimed at promoting road safety and mitigating work-related stress could thus play a crucial role in reducing preventable mortality during economic upturns.

A Appendix

Figure A4: Mortality Rate and Unemployment Rate



Source: author's elaboration on Eurostat data.

Table A7: Yearly Data on Unemployment Rate, Total Causes (deaths), Population, and Mortality Rate

Year	Unemployment Rate	Deaths	Population	Mortality Rate
2004	8.015	541,908	55,907,407	9.693
2005	7.745	565,149	56,328,280	10.033
2006	6.790	551,597	56,564,801	9.752
2007	6.087	565,638	56,778,738	9.962
2008	6.737	574,313	57,257,169	10.030
2009	7.764	581,159	57,663,165	10.079
2010	8.381	565,654	57,925,411	9.765
2011	8.377	574,990	58,174,169	9.884
2012	10.678	593,664	58,323,892	10.179
2013	12.175	579,937	58,489,728	9.915
2014	12.717	579,004	58,557,238	9.888
2015	11.929	624,875	58,507,343	10.680
2016	11.725	597,577	58,379,655	10.236
2017	11.242	629,469	58,285,332	10.800
2018	10.639	612,186	58,159,212	10.526
2019	9.982	620,018	58,042,345	10.682

Table A8: Total and proportions of deaths in total mortality by cause of death - Source: National Institute of Statistics (ISTAT)

Charachteristics	**Total of deaths**	**Percentage (%)**
Gender		
Men	4,657,266	48.54
Women	4,937,313	51.46
Causes		
Transport accidents	73,832	0.77
Suicide	63,225	0.66
Homicide	7,120	0.07
Cancer	2,800,677	29.19
Diabetes	331,475	3.45
Alzheimer	157,917	1.65
Circulatory system diseases	3,596,104	37.48
Digestive	370,826	3.86
Other accidents	242,148	2.52
Respiratory	685,677	7.15
Other diseases	1,265,578	13.19
Age group		
0-24	67,186	0.70
25-44	168,521	1.77
45-64	948,814	9.95
65-74	1,420,677	14.89
75+	6,933,325	72.69
Education level		
Elementary school certificate, no degree	7,050,636	73.92
Middle school certificate	1,571,212	16.47
High school diploma	664,404	6.97
University degree or diploma	252,293	2.64

Chapter 3

Leadership Matters? Managerial Turnover, Reform, and Performance in Italian Local Health Systems

This study investigates the impact of top management composition on the healthcare, economic, and financial performance of Italian Local Health Authorities (LHAs). The main objective is to assess whether and to what extent the characteristics of General Managers influence efficiency and quality within the healthcare system. The research lies at the intersection of two strands of literature: the effects of austerity measures on health outcomes, and the role of management in shaping organizational performance, which remains largely unexplored in the Italian context.
To provide a causal interpretation, Legislative Decree No. 171/2016, which introduced a national list of eligible candidates for the position of General Manager, is employed as an institutional shock within a staggered Difference-in-Differences framework (Callaway & Sant'Anna, 2021). This approach allows us to identify the effects of managerial turnover and renewal while exploring heterogeneity across regions and manager characteristics. Specifically, the analysis distinguishes between regions under recovery plans and those not subject to them, and examines whether the decree influenced the appointment of General Managers based on gender and educational background.

The analysis relies on an original dataset constructed from the curricula of General Managers and integrated with data from the Ministry of Health, AGENAS, and ISTAT for the period 2015–2021. Results reveal predominantly negative effects on healthcare performance, as evidenced by an increase in 30-day mortality rates following femoral neck fracture surgery in the post-reform period.
Overall, the study shows that the reform provides a valuable setting to examine the role of managerial human capital in the public healthcare system, suggesting that transparency in selection processes alone is not sufficient to ensure improved organizational performance.

Keywords: Public healthcare management • Managerial turnover • Local Health Authorities • Healthcare performance • Staggered Difference-in-Differences • Governance reform • Italy

JEL Classification: D24 • G34 • I11 • I18 • J45 • M54 • O15

3.1 Introduction

The performance of public healthcare organizations depends critically on the quality of their leadership. As noted by Drucker (2002), organizational success is inherently tied to the people who guide it—a statement that is particularly salient in the health sector, where managers coordinate highly specialized professionals, complex technologies, and constrained resources to achieve both efficiency and clinical quality. In recent years, a growing body of work has underscored the importance of managerial skills and leadership in shaping performance in both private and public healthcare settings. Evidence shows that better-managed hospitals achieve lower mortality rates, higher productivity, and improved patient satisfaction (Bloom et al., 2020; Tsai et al., 2015; Asaria et al., 2022; Janke et al., 2019). Similar findings emerge across public services more broadly, where managerial talent and identity influence organizational outcomes ranging from educational achievement to procurement efficiency and public sector productivity (Bertrand & Schoar, 2003; Best et al., 2023; Fenizia, 2022; Lavy et al., 2023).

Despite this expanding literature, empirical evidence on causal managerial effects in public healthcare remains limited. Identifying the impact of top managers is intrinsically challenging: hospital and health authority leaders are typically not randomly assigned, their skills are difficult to measure, and organizational dynamics may confound observable performance. For these reasons, policy shocks that alter the selection or appointment of managers offer unique opportunities to deepen our understanding of how leadership shapes healthcare performance. A recent example is provided by Muñoz and Otero (2025), who exploit a civil service reform in Chile to show that recruiting more qualified hospital CEOs led to significant reductions in mortality. Yet such quasi-experimental settings are rare, and the role of managerial selection in European healthcare systems—especially those characterized by strong regional autonomy and political involvement in appointments—remains underexplored.

The Italian National Health Service (NHS) represents a particularly compelling setting for this type of investigation. Over the last decade, Italian regions have been confronted with persistent financial pressures, staff shortages, and growing territorial inequalities in access and quality of care (Ghislandi et al., 2025; Arcà et al., 2020; Guccio et al., 2024). In parallel, concerns about governance quality and the politicization of appointments have intensified. Local Health Authorities (LHAs) are pivotal actors in the system: they manage hospital networks, coordinate primary care, allocate budgets, and oversee prevention and community health services. Their General Managers ("Direttori Generali", GMs) exercise substantial discretion over strategic planning, resource distribution, and performance monitoring. However, GMs were historically appointed through procedures that allowed wide political discretion, raising concerns about meritocracy, transparency, and the match between managerial competencies and organizational needs.

In response to these concerns, Legislative Decree 171/2016 introduced a major reform of the appointment system for LHA General Managers. The reform mandated the creation of a national list of eligible candidates, subject to uniform requirements and selection procedures, with the stated objectives of increasing transparency, limiting political discretion, and ultimately improving the quality of managerial appointments. Although regions retained the authority to choose GMs from the national list, the reform introduced substantial changes in the pool of available candidates and in the institutional constraints governing selection.

This paper exploits the staggered implementation of Legislative Decree 171/2016 across Italian regions as a source of quasi-experimental variation to examine whether changes in top management composition affect LHA performance. Building a novel dataset that integrates administrative records, Ministry of Health and AGENAS indicators, ISTAT data, and manually collected curricula of General Managers for 2015–2021, we analyze how the reform altered managerial turnover, the characteristics of appointed GMs (including education, gender, and professional background), and key measures of economic-financial and clinical performance.

Our empirical strategy relies on a staggered Difference-in-Differences framework (Callaway & Sant'Anna, 2021), which allows us to isolate the differential timing of reform adoption across regions and assess its causal effects on both managerial characteristics and performance outcomes. This approach enables us to move beyond descriptive associations and provide rigorous evidence on whether increasing formal transparency in appointment processes translates into improved organizational performance.

We report three main findings. First, the reform significantly changed the composition of top management, increasing turnover and altering the profiles of GMs appointed after 2016. Second, despite these shifts in leadership, we find limited evidence of performance improvements and, in some clinical indicators—most notably 30-day mortality following femoral neck fracture surgery—performance appears to worsen in the post-reform period. Third, the results suggest that transparency and formalization in managerial selection, although normatively appealing, may be insufficient to enhance performance in systems characterized by fiscal stress, high complexity, and strong regional variation. In particular, constraints on managerial autonomy, shortages of clinical staff, and region-specific governance arrangements may limit the potential benefits of improved selection mechanisms.

This study contributes to several works in the literature. It adds to research on the role of managers in public sector performance by providing the first causal evidence on how changes in top management selection affect the performance of Italian LHAs. It also enriches the literature on healthcare governance, highlighting the challenges of improving performance through institutional reforms that do not simultaneously address broader organizational constraints. Finally, it informs ongoing policy debates on the professionalization of public healthcare management, suggesting that transparency reforms must be accompanied by investments in managerial training, clearer accountability frameworks, and organizational support mechanisms.

The rest of the paper is organised as follows. Section 3.2 provides background on the institutional setting of the Italian National Health Service, describes the role and appointment process of Local Health Authority General Managers, and outlines the main features of Legislative Decree 171/2016. Section 3.3 presents the empirical methodology, detailing the staggered adoption of the reform across regions and the Difference-in-Differences identification strategy. Section 3.4 describes the data sources, the construction of the managerial dataset, and the performance indicators used in the analysis. Section 3.5 reports the main results on how the reform affected managerial turnover, the characteristics of appointed General Managers, and the economic and clinical performance of LHAs. Section 3.6 concludes by discussing the implications of our findings for healthcare governance and the design of managerial selection systems.

3.2 Institutional Background

The Italian National Health Service (NHS) was established by Law n.833 in 1978, introducing a universal, Beveridge-style system financed through general taxation. This reform replaced the previous fragmented, occupation-based insurance funds (”casse mutue”).

The system guarantees universal coverage, provided either free of charge or with relatively modest co-payments (Ferré et al., 2014). It operates across three administrative tiers — national, regional, and local. The national level is responsible for developing nationwide health plans that establish general health objectives and defining the ”Essential Levels of Care” (Livelli Essenziali di Assistenza, LEA), the basket of services that must be guaranteed across the entire country, which must then be achieved by the regional health departments. The regional health departments are, in turn, responsible for achieving these objectives and ensuring the provision of healthcare services through Local Health Authorities (LHAs).

Since its establishment, the Italian NHS has undergone several reforms aimed at enhancing managerial accountability and containing costs through greater decentralization. Today, the central government collects most of the financial resources for the NHS and redistributes them to the regions (Lo Scalzo et al., 2009), which hold spending autonomy — a principle introduced by Legislative Decrees 446/1997 and 56/2000. The allocation of funds considers each region’s resident population and adjusts it mainly by age, with additional (smaller) adjustments for premature mortality and socio-economic conditions, to better reflect healthcare needs across regions. This decentralized architecture has effectively created 21 distinct regional health systems, turning the NHS into a ”natural laboratory” for economic analysis (Atella et al., 2019), particularly for studying the causes of regional performance gaps (Bordignon et al., 2020).

The coexistence of multiple levels of governance, combined with the constitutional guarantee of universal health coverage (Art. 32), has long posed challenges to the financial sustainability of the system (France et al., 2005). Levaggi and Menoncin (2013) argue that regions often behaved under the assumption that their health-related debts would ultimately be covered by the central government in the event of default and formalize this behavior in a theoretical model consistent with such expectations.

The consequences were severe: by 2006, the healthcare deficit reached approximately €6 billion (Ministero dell'Economia e delle Finanze – Ragioneria Generale dello Stato, 2015), with the largest shortfalls recorded in Lazio and Campania. To restore the financial sustainability of the NHS, the central government introduced targeted recovery programs, known as ”*Piani di Rientro*”, which are still in place and continue to be enforced to this day. These plans aim to achieve a structural reorganization of regional healthcare systems by addressing the underlying factors driving economic and financial imbalances.

The Central Government provides support to regions that have signed an agreement in two main forms: (i) financial resources—to offset accumulated regional health-care debts—and (ii) governance and performance oversight through a standardized monitoring framework.

Regarding financial support, three channels were activated (Ministero dell'Economia e delle Finanze – Ragioneria Generale dello Stato, 2015):

- a transitional fund, co-financed by the Central Government and non-treated regions, to prevent an abrupt contraction of health-care spending in treated regions;

- state loans totaling 9 € billion to further sustain these regions;
- an additional 3 € billion in earmarked transfers for treated regions that increased own-source revenues via regional taxation.

As for managerial and evaluative support, the Ministry of Health and the Treasury oversee implementation through SiVeAS, the Ministry of Health's monitoring system. This uniform framework conducts continuous assessments of: (1) the documentation produced and the coherence of each region's measures with the objectives agreed with the Central Government; and (2) the appropriateness and quality of care, to ensure delivery of the essential levels of care (LEA) efficiently.

Within each recovery-plan agreement, regions are required to meet targets in terms of cost containment and health outcomes; failure to do so triggers mandatory increases in regional taxation. Region-specific targets are established via a SWOT analysis (strengths, weaknesses, opportunities, threats) and are detailed in the documentation submitted by each region.
As shown in Figure B4, the implementation of regional recovery plans began in 2007. The figure reports, for each region, the years of participation in the plan, highlighting a heterogeneous pattern of adoption and duration. Specifically, Liguria and Sardegna experienced early and short-lived plans between 2007 and 2010, while Piemonte joined in 2010 and exited in 2017. In contrast, Lazio, Abruzzo, Campania, Molise, Calabria and Puglia have been continuously under recovery plans since their initial adoption—most of which took place in 2007, while for Calabria it was in 2009 and for Puglia in 2010—remaining bound by these agreements throughout the entire 2015–2021 window.

The 2016 General-Manager Reform (D.Lgs. 171/2016) The figure of the General Manager (GM) was introduced with the 1992 hospital–managerial reform (*D.Lgs.* 502/1992, as amended by *D.Lgs.* 517/1993 and *D.Lgs.* 229/1999), which transformed Local Health Units into public "enterprises" and made the GM the legal representative and chief executive officer of each Local Health Authority (LHA) and hospital trust. Appointment powers were assigned to regional governments; the GM, hired on a fixed-term private-law contract, was entrusted with full responsibility for budgeting, organization, and performance, and with the power to appoint the medical and administrative directors.

Prior to the 2016 overhaul, eligibility and selection procedures were largely decentralized. Regions conducted calls and interviews based on their own regulations, typically requiring a university degree, proven management experience (preferably in health care), and the absence of incompatibilities; performance targets and grounds for dismissal were defined in regional contracts and programs. In practice, however, the absence of a national accreditation mechanism produced substantial cross-regional heterogeneity in both entry requirements and evaluation practices, with wide discretion in the documentary screening of curricula and in the weighting of interview results. Transparency obligations existed but were unevenly enforced, and no centralized roster constrained the choice set of regional appointing authorities.

The accumulated evidence on managerial heterogeneity and the calls for professionalization in healthcare governance set the stage for an institutional redesign of the appointment process. The 2016 decree responds precisely to these concerns, introducing centralized eligibility, uniform evaluation criteria, and enhanced transparency—elements that materially alter the selection environment faced by regional authorities. To lend our analysis a solid causal interpretation, we exploit Legislative Decree No. 171 of August 4, 2016, as an exogenous institutional shock that enables the implementation of a staggered difference-in-differences strategy: we define treatment at the LHA level as the effective onset of the new rules for appointing General Managers, operationally made possible by the publication of the first national list of eligible candidates in 2018, and we take as controls the LHAs that are not yet treated at time t and those never treated within the 2015–2021 window.

Several studies have underlined the need for a renewal in healthcare management structures (Baker, 2001). In line with these reflections, the 2016 reform partially responds to the call for greater professionalization and competence among healthcare leaders. In particular, the Legislative Decree of August 4, 2016 No. 171, introduced a comprehensive reform of the appointment process for General Directors within the Italian National Health Service, with the aim of standardizing procedures, enhancing transparency, and elevating the competence of appointees. Prior to the decree, selections were managed independently by regional authorities, generating substantial cross-regional variability. Criteria for assessing candidates' qualifications and experience were uneven, and the absence of a centralized accreditation mechanism left room for discretion. Moreover, the process was often opaque, with limited publication of selection criteria and outcomes, thereby constraining accountability.

The decree established a centralized national roster, managed by the Ministry of Health, of eligible candidates who satisfy clearly defined requirements, including a university degree; documented managerial experience of at least five years in the health sector or seven years in other sectors; and formal training in public health and healthcare management. The roster was originally intended to be updated biennially, but in practice it is revised on an annual basis to maintain rigor and relevance. Regional authorities must now appoint directors exclusively from this list, following a transparent evaluation that combines documentary assessment of qualifications with interviews. To strengthen accountability, the outcomes of the procedure—together with the curricula of appointed and non-appointed candidates—must be publicly disclosed.

The reform also introduced uniform standards for the performance evaluation of appointed directors. These criteria emphasize the attainment of health and service-efficiency goals, compliance with financial discipline and administrative transparency, and alignment with regional and national healthcare objectives. By centralizing eligibility, standardizing selection and evaluation procedures, and strengthening disclosure, the decree is designed to promote meritocracy, mitigate regional disparities, and improve governance and effectiveness across Italy's healthcare system.

3.3 Methodology

The primary objective of this paper is not to evaluate the overall impact of Legislative Decree 171/2016 as a policy in its own right, but rather to use the reform as a source of plausibly exogenous variation to address the core research question of whether the composition of top management causally affects the economic–financial and clinical performance of Local Health Authorities (LHAs). The decree introduced stricter and more transparent eligibility criteria for General Managers and triggered a gradual reshaping of management teams across LHAs. We interpret this institutional change as a quasi-experimental shock to managerial composition and quality and exploit it to identify the causal effect of management characteristics on organisational and clinical outcomes.

As a starting point, we rely on difference-in-differences (DiD) models with two-way fixed effects (TWFE). The basic specification is

$$Y_{lt} = \mu_l + \lambda_t + \beta^{TWFE} D_{lt} + \varepsilon_{lt}, \tag{3.1}$$

where Y_{lt} denotes the outcome of interest for LHA l at calendar year t (e.g., the economic–financial and clinical indicators listed in Table 1); μ_l and λ_t are LHA and year fixed effects, respectively; D_{lt} is an indicator equals to one in all years in which LHA l is governed by a General Manager appointed under the new eligibility rules and zero otherwise. Under the standard DiD assumptions, in particular the parallel trends condition, β^{TWFE} can be interpreted as an overall average treatment effect on the treated (ATT) in the post-reform period.

To investigate the dynamics of the reform's impact and to assess the plausibility of the parallel trends assumption, we also estimate TWFE event-study regressions of the form

$$Y_{lt} = \mu_l + \lambda_t + \sum_{k \leq -2} \delta_k D_{lt}^k + \sum_{k \geq 0} \delta_k D_{lt}^k + \varepsilon_{lt}, \tag{3.2}$$

where D_{lt}^k is an event-time dummy that equals one if observation (l, t) is k years away from the first application of the decree in LHA l and zero otherwise. We normalise the year immediately preceding the first eligible appointment ($k = -1$) as the reference period and omit it from the regression. The coefficients $\delta_{k\geq 0}$ trace out the evolution of the ATT over time since treatment, while the lead coefficients $\delta_{k\leq -2}$ capture pre-treatment differences in trends and are conventionally used to test for violations of the parallel trends assumption. In line with common practice, we may also collapse very distant leads and lags into bins when estimating equation (3.2) in order to avoid noisy estimates in periods with few observations.

Our institutional setting is well suited for a DiD strategy. First, a sizable number of LHAs became exposed to the reform at different points in time, which generates the staggered adoption pattern required for identification. Second, the legislative decree is defined at the national level and introduces harmonised, more stringent and transparent criteria for the selection of General Managers, thereby limiting the scope for local authorities to time adoption strategically in response to unobserved shocks. Third, the panel nature of the data provides several pre- and post-reform years, allowing us to condition on rich fixed effects (μ_l and λ_t) that control for time-invariant LHA characteristics and for nationwide shocks common to all units. These features make the parallel trends assumption a reasonable starting point, which we then scrutinise empirically using the event-study coefficients.

Nonetheless, a growing methodological literature has shown that TWFE estimators can be severely biased in settings with multiple periods, staggered adoption and heterogeneous treatment effects across cohorts and over time (Borusyak et al., 2024; Callaway & Sant'Anna, 2021; De Chaisemartin & d'Haultfoeuille, 2020; Goodman-Bacon, 2021; Sun & Abraham, 2021). The estimand $\hat{\beta}^{TWFE}$ in Eq. 3.1, as well as the event-study coefficients $\hat{\delta}_k$ in Eq. 3.2, can be contaminated by several mechanisms: implicit variance weighting in the OLS regression; the use of already-treated units as controls for later-treated units, which generates so-called "forbidden comparisons" (Goodman-Bacon, 2021); and non-trivial heterogeneity in treatment effects across LHAs and cohorts, which leads TWFE to recover a non-convex combination of cohort- and time-specific effects rather than a meaningful ATT (Sun & Abraham, 2021). As a result, TWFE estimates may be difficult to interpret and may even have the wrong sign.

To address these issues and obtain estimates that are robust to heterogeneous treatment effects under staggered adoption, we complement the TWFE analysis with the estimator proposed by Callaway and Sant'Anna (2021) (henceforth CSA[1]). This approach explicitly exploits variation in the timing of treatment across LHAs and builds its estimands on cohort- and time-specific average treatment effects.

3.3.1 Staggered DiD

The CSA framework is based on a collection of average treatment effects at calendar time t for the cohort of LHAs that first became treated at time c, denoted $ATT(c,t)$. In our context, cohorts are defined by the year in which the LHA first appoints a General Manager selected from the national eligibility list. Following the notation in Roth et al. (2023), and focusing on the post-treatment period ($t \geq c$), the cohort-time effects can be written as

$$ATT(c,t) = E\big[Y_{lt} - Y_{l,c-1} \mid C_l = c\big] - E\big[Y_{lt} - Y_{l,c-1} \mid C_l = NT\big], \tag{3.3}$$

where $C_l = c$ indicates that LHA l is first treated in the calendar year c, and $C_l = NT$ denotes LHAs that are *never treated* over the sample period, or *not-yet treatead* up to time *t*. Intuitively, $ATT(c,t)$ compares the change in outcomes between $c-1$ (the last pre-reform year for cohort c) and t for LHAs in cohort c with the corresponding change for units in the control group.

In the implementation based on the *not-yet treated* comparison group, the control group at time t includes both never-treated LHAs and those that will be treated in the future but have not yet implemented the decree by year t. Analogously, for pre-treatment periods ($t < c$) one can define

$$ATT(c,t) = E\big[Y_{lt} - Y_{l,t-1} \mid C_l = c\big] - E\big[Y_{lt} - Y_{l,t-1} \mid C_l = NT\big], \tag{3.4}$$

which are expected to be equal to zero under the parallel trends and no-anticipation assumptions and are useful for formal pre-trend tests.

[1] We use the csdid package to estimate CSA models in Stata 18

The staggered rollout of the policy fits naturally into this framework. The adoption of the new eligibility and appointment criteria for General Managers is an absorbing state: once an LHA appoints a GM in compliance with the decree, the new rules remain in force in all subsequent years within our observation window. Anticipation effects are unlikely to be substantial. The policy became effectively operational with the publication of the first national list of eligible candidates in 2018, which provided LHAs with concrete information on the available pool of managers. Before 2018, both the composition of the list and the timing of its implementation were uncertain, and the actual application of the new rules was tied to fixed appointment cycles and regional administrative procedures that were activated only close to the relevant renewal windows. This combination of limited actionable information prior to 2018 and institutional constraints on appointment timing reduces the scope for systematic pre-treatment behavioural adjustments by LHAs.

In our empirical work, we first estimate the cohort-time effects $ATT(c, t)$ and then use them to construct a set of aggregated estimands that summarise the impact of the reform. We rely on the doubly robust influence-function estimator, which combines inverse probability weighting with outcome regression adjustment and delivers consistent estimates of $ATT(c, t)$ provided that either the propensity score model or the outcome model is correctly specified, but not necessarily both. For inference, all standard errors are clustered at the LHA level and obtained via wild bootstrap with 999 replications. This choice is motivated by the relatively small number of clusters and the presence of staggered treatment timing, for which bootstrap procedures typically provide more reliable finite-sample inference than purely asymptotic variance formulas.

To summarise the cohort-time specific effects, we report both horizon-specific dynamic effects and overall average effects. The latter are obtained by averaging $ATT(c, t)$ over post-treatment periods and cohorts using the aggregation rules proposed by Callaway and Sant'Anna (2021); in practice, we focus on the simple average, weighting cohorts by their size. In addition, we recover event-time coefficients relative to the year of first exposure and use them to construct event-study profiles and to perform formal pre-trend tests, examining whether the estimated effects in the pre-treatment periods are statistically indistinguishable from zero. These heterogeneous-treatment estimators are presented alongside the TWFE results, which we retain as a familiar benchmark but interpret with caution in light of the potential biases discussed above.

Definition of treatment and control groups

In our setting, the unit of treatment is the Local Health Authority (LHA). We classify as "treated" those LHAs that, starting in 2018, appointed for the first time a General Manager (GM) who had not previously held the position and who was listed in the national roster of eligible candidates. The treatment indicator D_{it} switches to 1 in the year when LHA *i* makes its first appointment compliant with the new criteria (post-publication of the eligibility list) and remains equal to 1 thereafter (irreversibility). Within the Callaway–Sant'Anna framework, the control group in each year *t* consists of LHAs not yet treated and LHAs never treated.

In 2021, the total number of Italian LHAs is 99 (Ministry of Health). We classify treated units into cohorts by year of first implementation, distinguishing early adopters (*n=13*) and late adopters (*n=53*), while the never adopters group comprises *33* LHAs that, by 2021, had not yet appointed for the first time a GM drawn from the national eligibility list. This cohort stratification enables the estimation of cohort-by-time treatment effects $ATT(c, t)$ and transparent comparisons of outcome dynamics across early, late, and never adopters.

In implementing the Callaway–Sant'Anna estimators, we consider both the "never-treated" and the "not-yet-treated" comparison group strategies. Under the never-treated approach, the control group is composed exclusively of LHAs that are never exposed to the reform over the entire observation window; all LHAs that receive the treatment at any point are excluded from the control group in all periods. By contrast, under the not-yet-treated approach the control group at time t includes both LHAs that are never treated and those that will be treated in the future but have not yet implemented the reform by period t—that is, late adopters contribute to the control group up to the year of their first compliant appointment. This latter strategy is our preferred specification, as it exploits the staggered timing of adoption, makes use of the full panel of LHAs and yields a larger and more comparable risk set over time. Nevertheless, for the sake of coherence and to ensure that our findings are not driven by the choice of comparison group, we also estimate the models using the never-treated design and report these results as a robustness check.

3.4 Data

The analysis relies on an original dataset of Italian Local Health Authorities (LHAs) with annual coverage for 2015–2021. The statistical unit is the LHA_i observed in year t. In our analysis, we consider a total of 99 LHAs, corresponding to the number operating in Italy in 2021, which is the final year of our observation period. The sources are linked using consistent administrative keys (LHA and regional codes). In the event of organizational restructuring (mergers/splits), the series are harmonized in accordance with their 2021 list. The complete list of LHAs included in the study is reported in Table B11. This time span provides a common three-year pre-treatment period (2015–2017) and a post-treatment period (2018–2021) sufficient to estimate dynamic effects consistent with a staggered DiD design.

The dataset construction combines three information families and an original archive. Organizational and activity information at the LHA level includes volumes, structural characteristics, and, where available, departmental quality/appropriateness measures, which are used both as outcomes (where relevant) and as structural covariates in the conditional analysis. Clinical outcomes are sourced from *Agenas* and are used in their standardized and, where applicable, risk-adjusted form[2].

A distinctive contribution of our dataset is the construction of a comprehensive historical registry

[2]**Risk-adjusted**: this statistical procedure is necessary for comparative evaluations and accounts for existing heterogeneity in patient populations, such as differences in age, gender, severity of the pathology, and comorbidities, which can act as confounding factors . For a detailed discussion of the risk adjustment methodology used, see Appendix C.

of Local Health Authority General Managers (GMs) in a context where *no centralized, public archive* of GM appointments exists. Although LHAs are formally required to maintain an internal record of GM appointments and renewals, such historical information is not systematically available across LHA websites, and coverage is heterogeneous.

In addition to the other sources described above, we have therefore assembled an original archive on GMs. For each general manager, we searched for downloaded and coded their respective CVs. Curricula vitae were coded and supplemented with a systematic search on Google and Google News, conducted for each LHA and each year from 2015 to 2021 (and, where necessary to reconstruct appointment histories, also for earlier years when available), aimed at identifying appointment decrees and regional resolutions, as well as relevant press articles. The replicable protocol involved structured queries (combinations of the "ASL/ASST/ATS" name with "direttore generale/DG," "nomina/decreto/delibera," and the reference year), extraction and archiving of links, recording of access dates, and triangulation between official acts and press coverage; in the event of discrepancies, priority was given to administrative documentation.

Beyond GM incumbents, we also extracted information from curricula for the *full constructed history of GM appointments* and, starting in 2018, we parsed the national lists of *eligible candidates* for the GM position to recover additional characteristics of the candidate pool. This procedure allows us to precisely date the start/end of mandates and GM turnover and to derive measures of managerial capital (education, prior experience, tenure length, date of birth, and gender), some of which are used as controls and for heterogeneity analysis.

The economic–financial outcomes include the Operating Margin (net operating income, in thousand euros), the Gross Operating Surplus (gross operating income, in thousand euros), the Revenue-to-Cost Ratio (production value divided by production costs), the Financial Viability Index (a composite index of overall economic balance) and the measures of Patient Mobility (extra region passive/active mobility); these are standard accounting-based measures of hospital performance in applied micro-evaluations. The health outcomes comprise Femur 30d mortality (30-day mortality after femoral neck fracture; our primary outcome), Hip 30d readmissions (30-day readmissions after hip replacement), the share of Femur surgery $\leq 2d$ (surgery within two days for femoral neck fracture) and Hip revisions $\leq 2y$ (revision within two years after hip replacement). Within economics, mortality, timely access, and readmissions are canonical “hard” quality indicators in studies of hospital choice and competition (e.g., Cooper et al., 2011). Crucially for our setting, Brekke et al. (2021), in an econometric analysis of hospital competition published in the Journal of Health Economics, cite direct evidence (specifically, Moscelli et al., 2018) demonstrating that competition led to a statistically significant reduction in 30-day hip fracture mortality following the English patient-choice reform.

It is important to emphasize that while the terms ”hip” and ”femur” are not literally identical, they are used interchangeably in medical and clinical contexts to describe this specific injury. Authoritative medical sources define a ”hip fracture” not as a fracture of the pelvic bone, but specifically as a fracture of the upper (proximal) part of the femur. For example, Emmerson et al. (2023) specifies that ”the terms hip fracture and neck of femur fracture are used synonymously.” Furthermore, Goldacre et al. (2002), have specifically used the term ”fractured neck of femur” to analyze post-admission hospital mortality at 30, 90, and 180 days. For hip replacement, 30-day readmissions and PROM-based indicators are employed as provider-performance measures in patient-choice models (Gutacker et al., 2016). Evidence on competition and quality in elective orthopaedics also supports the use of time-sensitive measures such as our Femur surgery $\leq 2d$ indicator (see Moscelli et al., 2021). Health outcomes are used, where provided by the sources, in their risk-adjusted form. Monetary variables are expressed in thousand euros; for highly skewed variables we apply $log(1 + x)$ transformations or standardization to enhance coefficient interpretability and the robustness of inference. The variables are described and presented in Table 1.

The main sample includes LHAs with at least three pre-treatment periods and two post-treatment periods within 2015–2021, which is the minimum requirement for inclusion in the dynamic (event-study) analysis: each LHA must have ≥ 3 periods before and ≥ 2 periods after its own first year of implementation. In addition, we estimate models on restricted samples that distinguish LHAs located in regions subject to the Recovery Plan from those in regions not subject to the Plan, in order to assess treatment-effect heterogeneity under differing financial and regulatory constraints.

By Recovery Plan we refer to the set of agreements between the State and regions exhibiting sizable health-care deficits, introduced from 2007 (within the framework established by Law 311/2004 and Decree-Law 159/2007), aimed at rebalancing regional health accounts while complying with the Essential Levels of Care (LEA) and accompanied by operational programs for reorganization/qualification, stringent monitoring, and, in the most critical cases, support/commissioner measures.

The regions under recovery plans are presented in figure B4. As shown in the table, all regions involved in recovery plans are listed; however, in our analysis, we consider only those that remained under a recovery plan for the entire observation period. Specifically, for the 2015–2021 window these are: Lazio, Abruzzo, Campania, Molise, Sicilia, Puglia, and Calabria (source: Italian Ministry of Health).

Additional descriptive statistics on the variables used in the analysis are reported in Appendix B.4, which provides further information on the data employed in this study.

3.5 Results

We begin our analysis by contrasting the benchmark TWFE estimates with the staggered-robust Callaway–Sant'Anna (CSA) estimates (reported in table 2, *Panel a* and *Panel b*, respectively). Across the two specifications, the economic–financial outcomes exhibit no statistically discernible effects. Turning to clinical performance, most indicators (*Hip 30d readmissions*, *Femur surgery* $\leq 2d$, *Hip revisions* $\leq 2y$) are statistically indistinguishable from zero in both estimators. For

Variable	Description	Desirable Coefficient
Economic and Financial Performance		
Operating Margin	Net operating income (in thousands of euros)	Positive
Gross Operating Surplus	Gross operating income (in thousands of euros)	Positive
Revenue-to-Cost Ratio	Production value / Production cost	Positive
Financial Viability Index	General economic equilibrium index	Positive
Patient Mobility	Passive mobility / Active mobility (outside region)	Negative
Health and Quality Indicators		
Femur 30d mortality	30-day mortality for femoral neck fracture	Negative
Hip 30d readmissions	30-day readmissions after hip replacement	Negative
Femur surg. $\leq 2d$	Surgery within 2 days for femoral neck fracture	Positive
Hip revision $\leq 2y$	Revision within 2 years after hip replacement	Negative
Case-Mix Index (CMI)	Compensation index	Negative

Table 1: List of Variables

our primary outcome, *Femur 30d mortality*, we detect a positive, marginally significant effect of the reform in both TWFE and CSA (average increase of 0.52 and 0.6 percentage points, respectively, significant at the 90% confidence interval for the TWFE estimator and at the 94% for the CSA estimator), implying a worsening, represented by an increase in mortality 30 days after femur surgery, following adoption. While the magnitude is modest and the precision limited, the sign and significance are consistent across estimators, which increases the salience of this finding. Pre-trend diagnostics reported alongside the tables do not reject parallel trends (TWFE $p \approx 0.92$; CSA $p \approx 0.51$), supporting the identifying assumptions.

As a corroboration of the preceding analysis, the two event studies, reported in Figure B2 for the TWFE specification and in Figure 1 for the Callaway–Sant'Anna approach, display very similar profiles: in the pre-treatment period, coefficients fluctuate around zero with wide confidence intervals and no evidence of differential trends, whereas after the reform's adoption the estimates turn positive and remain small in magnitude (on the order of roughly one-half to one and a half percentage points), with at most marginal significance at certain horizons. The fact that the profile obtained with the Callaway & Sant'Anna approach—robust to staggered adoption—is broadly comparable to that estimated with the Two-Way Fixed Effects model, despite TWFE's known sensitivity to heterogeneous treatment effects, reinforces the interpretation of a modest post-reform deterioration in the outcome under study.

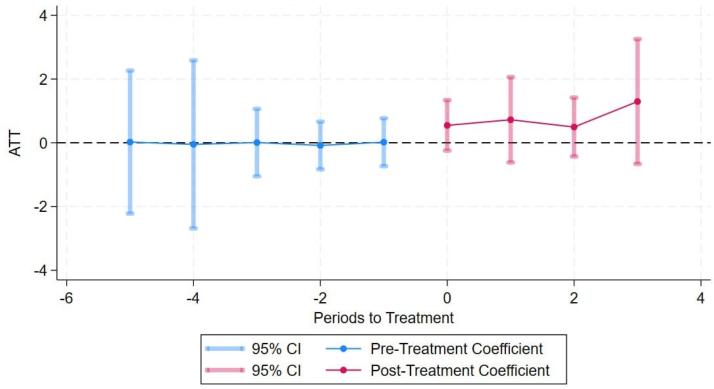
To assess whether a staggered DiD estimator, such as the Callaway & Sant'Anna estimator, should be preferred to the conventional TWFE approach, we implement the Goodman–Bacon decomposition on 30-day femur mortality. Figure B3 (Bacon decomposition results: Femur 30d mortality) plots each underlying 2×2 DiD comparison (estimate on the vertical axis; weight on the horizontal; colors by comparison type). Three facts emerge. First, the treated vs never-treated component carries the largest weight (≈ 0.627) with a positive DiD (≈ 0.426), indicating that the TWFE coefficient is primarily driven by contrasts with never-treated units. Second, treated–treated comparisons are non-negligible: early vs later adopters contribute a sizable share (weight ≈ 0.259; DiD ≈ 0.803) and later vs earlier adopters add a smaller positive component (weight ≈ 0.112; DiD ≈ 0.408). Third, the presence of meaningful treated–treated mass, combined with heterogeneous effects across timing groups, is precisely the configuration in which TWFE can produce aggregation bias in staggered adoption.

Taken together, the tables and Figure B3 justify our empirical choice to prioritize CSA as the main estimator and to use TWFE as a descriptive benchmark. Substantively, we find no measurable short-run gains in the economic–financial indicators and largely null effects on secondary clinical metrics, while a weak but consistent adverse signal emerges for 30-day post-femur-surgery mortality. This pattern is consistent with a reform that primarily affects governance and managerial selection rather than clinical processes directly, an interpretation aligned with our research question on whether the overall composition of the managerial team influences the health, economic, and financial performance of Local Health Authorities. The modest and context-dependent effects we detect suggest that managerial composition may matter, but its impact is likely mediated by implementation quality, adoption timing, and region-specific constraints, dimensions that we probe in the subsequent heterogeneity and robustness analyses.

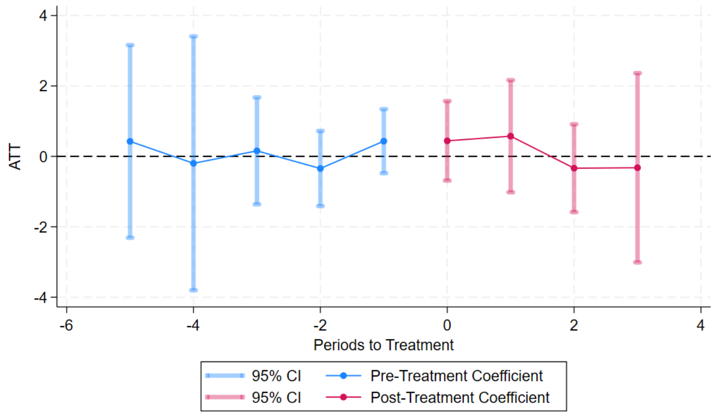
Table 2: Two-way fixed effects Difference-in-Differences and Callaway & Sant'Anna estimates (Not-Yet-Treated method), Pooled sample

Panel a: Two Way Fixed Effect				
Outcomes	Coeff.	S.E.	P-Value	PreTrend Test
Operating Margin	0.510	(1.064)	0.633	
Gross Operating Surplus	-0.013	(0.468)	0.978	
Financial Viability Index	0.000	(0.002)	0.965	
Revenue-to-Cost Ratio	0.000	(0.002)	0.963	
Patient Mobility	46.599	(53.828)	0.389	
Femur 30d mortality	0.523*	(0.293)	0.077	0.9193
Hip 30d readmission	0.040	(0.232)	0.863	
Femur surg. $\leq 2d$	0.686	(2.180)	0.754	
Hip revision $\leq 2y$	0.200	(0.201)	0.321	
Case-Mix-Index	-0.002	(0.003)	0.568	

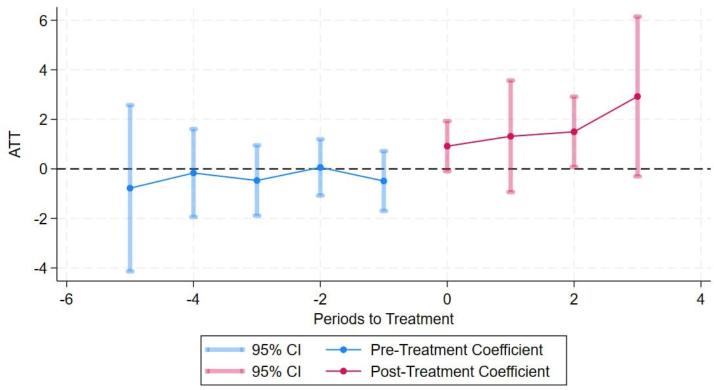
Panel b: Callaway And Sant'Anna model				
Outcomes	ATT	S.E.	P-Value	PreTrend Test
Operating Margin	0.341	(1.293)	0.792	
Gross Operating Surplus	0.671	(0.607)	0.270	
Financial Viability Index	0.003	(0.003)	0.366	
Revenue-to-Cost Ratio	0.002	(0.003)	0.372	
Patient Mobility	13.952	(16.432)	0.396	
Femur 30d mortality	0.605**	(0.295)	0.041	0.5080
Hip 30d readmission	0.253	(0.279)	0.365	
Femur surg. $\leq 2d$	-0.096	(1.967)	0.961	
Hip revision $\leq 2y$	0.246	(0.221)	0.266	
Case-Mix-Index	-0.001	(0.002)	0.427	



(a) Pooled sample



(b) Recovery plan = 0



(c) Recovery plan = 1

Figure 1: Comparison of three event study estimates of 30-day femur fracture mortality using the Callaway & Sant'Anna model: (a) Pooled sample, (b) LHAs in regions not under the recovery plan, (c) LHAs in regions under the recovery plan.

3.5.1 Heterogeneous Analysis

We perform a conditional analysis that differentiates between LHAs located in regions subject to the Recovery Plan and LHAs in regions not subject to the Plan. Specifically, we implement the Callaway–Sant'Anna framework on the full sample (pooled) and on restricted samples constructed separately for the two sets of regions. This design allows us to assess treatment-effect heterogeneity under distinct regional financial and regulatory constraints; in the estimates we report cohort-by-time effects $ATT(c,t)$ and their aggregations, and we systematically compare the pooled results with the restricted-sample ones.

Table B3 reports Callaway–Sant'Anna ATT estimates separately for LHAs *outside* (*Panel a*) and *within* (*Panel b*) the Recovery Plan, using not-yet-treated LHAs as controls within each subsample. Two patterns emerge. First, economic–financial outcomes remain null in both groups: coefficients for *Operating Margin*, *Gross Operating Surplus*, *Financial Viability Index*, *Revenue-to-Cost Ratio*, and *Patient Mobility* are small and statistically insignificant in *Panels a* and *b*, reinforcing the pooled finding of no short-run financial effects. Second, the adverse clinical signal concentrates in Recovery-Plan regions. For LHAs outside the Plan (*Panel a*), all clinical indicators are statistically indistinguishable from zero. By contrast, within the Plan (*Panel b*) *Femur 30d mortality* increases by about *1.11 percentage points* ($ATT = 1.112$, statistically significant at the 95% confidence level), while the remaining clinical indicators remain non-significant.

The positive coefficient on the variable *Femur 30d mortality* indicates a deterioration in health performance: holding other factors constant, adoption of the reform is associated with higher 30-day mortality among patients with femoral neck fractures. This adverse effect is more pronounced in LHAs under the Recovery Plan, precisely where tighter oversight and interventions are intended to foster gains in efficiency and quality. The finding is therefore at odds with the stated aims of the Plans: rather than a uniform improvement, we observe a concentrated adverse impact in the most constrained areas, suggesting that implementation mechanisms or local conditions may have muted, or even reversed, the expected quality improvements.

It is worth underscoring that we place primary emphasis on the Callaway–Sant'Anna estimates based on the *not-yet-treated* control group. This specification uses, in each period, not only the LHAs that are never treated but also those that have *not yet* adopted the reform as controls, thereby aligning the counterfactual with the staggered timing of implementation and avoiding comparisons among already-treated units. For completeness, we also estimated the model using the *never-treated* approach, which defines the control group exclusively on the basis of LHAs that are never exposed to the reform; the corresponding results (reported in the Table B4 in the Appendix) confirm the main evidence: no statistical significance for the economic–financial outcomes and a statistically significant positive coefficient for 30-day mortality after femoral neck fracture, indicating a deterioration in health performance. We prefer to foreground the model with the not yet treated method because (i) it maximizes the use of credible controls in each period under staggered adoption, (ii) it reduces reliance on a potentially small and atypical group of *never-treated* units, and (iii) it mitigates composition and weighting issues that can arise when pooling cohorts with heterogeneous adoption timing.

The results just discussed are confirmed and visualized in the event study for the *Femur 30d mortality* variable, shown in Figure 1. In the pooled sample (panel a), post-treatment coefficients trace an upward profile and include a statistically significant increase, consistent with a deterioration in health performance. A similar pattern emerges for LHAs within the Recovery Plan (panel c): post-treatment estimates increase, with some horizons reaching statistical significance, reinforcing that the adverse effect is concentrated in Recovery Plan regions. By contrast, for LHAs outside the Plan (panel b) the post-treatment path is downward-sloping, suggestive of an improvement (lower 30-day mortality), but none of the post-treatment coefficients is statistically different from zero. Taken together, the event-study profiles align with the ATT estimates reported above: no detectable effect outside the Plan and an adverse, statistically significant effect within the Plan, with the positive post-treatment coefficients signaling worse clinical outcomes rather than improvement.

3.5.2 Conditional Analysis

This subsection probes the stability of our main result by conditioning the CSA (not-yet-treated) estimates on pre-treatment, time-invariant covariates that proxy organizational capacity, demand/scale, and socio-economic context. We successively add average Staff, average Population served, and average Income—individually and in combination—to assess whether compositional differences along these dimensions account for the estimated effects. Specifically, Staff captures the internal organizational capacity and is calculated as the aggregate sum of physicians and nurses. To proxy for the external environment, the remaining covariates are measured at the municipal level: Population denotes the total number of residents[3], while Income represents the average municipal income, serving as a metric for the local socio-economic status.

Table B5 reports Callaway & Sant'Anna ATT estimates for our primary outcome (*Femur 30d mortality*) on the pooled sample using the *not-yet-treated* comparison group and conditioning on alternative sets of covariates. We sequentially include pre-treatment, time-invariant (or pre-period averaged) controls that proxy organizational capacity and case pressure: average *Staff* (Panel a), average *Population* served (Panel b), average *Income* (Panel c), and their pairwise and joint combinations (Panels d-e-f-g). Two results emerge. *First*, the effect is robust in sign and magnitude across all specifications: ATT estimates range from about 0.585 to 0.650 percentage points and are statistically significant at the 10% level (and in several cases at the 5% level), e.g., 0.624^{**} with *Staff* (Panel a), 0.632^{**} with *Income* (Panel c), and 0.607^{*} with the full set (Panel g). *Second*, pre-trend diagnostics do not reject parallel trends in any specification (PreTrend Test $\rho \approx 0.51$ for panel a; $\rho \approx 0.73$ for panel b; $\rho \approx 0.42$ for panel c; $\rho \approx 0.72$ for panel d; $\rho \approx 0.41$ for panel e; $\rho \approx 0.65$ for panel f and for panel g), supporting the identifying assumptions under these conditioning sets.

[3] Rome constitutes an exception. Since multiple LHAs operate within the same municipality, population figures were derived by aggregating the specific districts (*Municipi*) covered by the respective LHAs.

Substantively, the positive ATT continues to indicate a deterioration in health performance, higher 30-day mortality after femoral neck fracture, and its stability after controlling for organizational size (*Staff*), demand/scale (*Population*), and socio-economic context (*Income*) suggests that the result is not driven by compositional differences along these dimensions.

When covariates are included, identification relies on conditional parallel trends given time-invariant controls (Callaway & Sant'Anna, 2021). Our design follows this logic by conditioning on pre-period averages (*Staff*, *Population*, *Income*) and their combinations, treated as time-invariant proxies for baseline organizational and socio-economic characteristics; the similarity of the ATT across all conditioning sets reinforces the robustness of the main finding.

In line with the main findings, the conditional CSA (Not Yet Treated) estimates in Tables B6 - B7 show no effect outside the Recovery Plan and a robust adverse effect within the Plan. Adding pre-period, time-invariant controls one at a time (average Staff, Population, Income) and in combination, ATT estimates for Femur 30d mortality remain small and insignificant for LHAs outside the Plan (Table B6), whereas they are consistently positive and statistically significant for LHAs within the Plan (Table B7; e.g., 1.25 - 1.72 p.p. across single-control specifications and about 1.49 p.p. with the full set). The positive sign indicates a deterioration in health performance, higher 30-day mortality after femoral neck fracture following adoption, precisely in regions where Recovery Plans are intended to improve efficiency and quality.

Regarding identification, for the within-Plan splits, the pre-trend tests are systematically rejected (small $\rho - values$ across specifications). Nevertheless, the sign and magnitude of the within-Plan effect are stable across control sets, while the outside-Plan estimates remain uniformly null.

Moreover, Appendix B.3 presents a descriptive analysis of the impact of the legislative decree on the selection of general managers, examining differences by their professional background and gender.

3.6 Conclusion

This paper has examined whether and how the composition of top management shapes the economic–financial and clinical performance of Italian Local Health Authorities (LHAs). Rather than evaluating Legislative Decree 171/2016 as a policy reform in its own right, we have used it as a quasi-experimental source of variation in managerial selection. The introduction of a national eligibility list for General Managers (GMs) and the tightening of appointment criteria provided a natural experiment that reshaped the pool of candidates and the profiles of those appointed. Exploiting the staggered implementation of the new rules across LHAs over the period 2015–2021, we combined traditional two-way fixed effects Difference-in-Differences (TWFE) with staggered-robust estimators in the spirit of Callaway and Sant'Anna (2021) and, for binary outcomes, the JWDID approach proposed by Wooldridge and described by Rios-Avila (Rios-Avila et al., 2024). This empirical strategy has allowed us to isolate the contribution of managerial composition to organisational performance from confounding trends and institutional heterogeneity, and to speak to the broader empirical literature on management and performance in healthcare and other sectors (Bloom et al., 2015; Eldenburg et al., 2004).

Three main sets of findings emerge. First, when focusing on core organisational outcomes, we do not detect systematic improvements in economic–financial performance following the reform. Across both TWFE and Callaway–Sant'Anna specifications, the main indicators — Operating Margin (EBIT), Gross Operating Surplus (EBITDA), the Revenue-to-Cost Ratio, and the Financial Viability Index — display coefficients that are small in magnitude and statistically indistinguishable from zero. This suggests that, in the short to medium run covered by our observation window, the tightening of eligibility criteria for GMs and the ensuing managerial turnover did not translate into measurable gains in financial sustainability or efficiency at the LHA level. In other words, enhancing formal transparency and competence requirements in selection procedures, while desirable in itself, appears insufficient to generate automatic improvements in economic performance.

On the clinical side, results are more nuanced but point to a modest deterioration in our primary health outcome. For most of the quality indicators — 30-day readmissions after hip replacement, femur surgery within two days, and hip revisions within two years — we find no robust evidence of an effect of the reform. By contrast, both TWFE and Callaway–Sant'Anna estimates reveal a weak but consistent positive impact on 30-day mortality after femoral neck fracture, on the order of 0.5–0.6 percentage points on a baseline of around 6%. Although this effect is modest in absolute terms, it represents a non-trivial relative increase and is robust across alternative specifications, event-study profiles, and conditional models controlling for pre-period averages of staff, population, and income. The fact that we do not observe parallel systematic improvements in economic indicators reinforces the interpretation that the reform, as implemented, did not yield joint gains in financial and clinical performance and may have been associated with trade-offs in the management of acute, time-sensitive conditions, which is consistent with broader evidence on the sensitivity of emergency care outcomes to organisational choices (Chandra & Staiger, 2007).

The second set of results concerns the *managerial composition channel*, with a focus on the educational background of General Managers. Descriptive evidence shows that, in regions not subject to a Recovery Plan, the share of GMs with health-related degrees remained high and slightly increased after 2018, while the share of non-health degrees declined. In Recovery Plan regions, by contrast, we document a clear reversal: before 2018 most GMs held health-related degrees, whereas after the publication of the national list the majority of appointments shifted towards non-health backgrounds. Staggered DiD estimates confirm that this is not merely a descriptive pattern. Within the Callaway–Sant'Anna and JWDID frameworks, the probability that an LHA in a Recovery Plan region is headed by a GM with a non-health degree increases significantly after the reform, with no comparable shift in non-Plan regions. Our focus on educational background and degree type therefore complements recent work linking managerial education and management practices to hospital performance (Bloom et al., 2020).

These findings point to an interaction between the national reform and pre-existing financial and governance constraints. Recovery Plan regions operate under tight central oversight and strong pressure to restore budgetary balance. Within this setting, the new eligibility rules appear to have favoured candidates with legal, economic, or administrative training — profiles perceived as more suitable to navigate stringent fiscal and accountability requirements — at the expense of clinically trained managers. The reform, in other words, seems to have accelerated an ongoing transition from clinical to managerial leadership in the most constrained regional health systems, while leaving the managerial mix largely unchanged in financially more stable regions.

The third set of results relates to *gender composition and diversity* in leadership. We document a clear and persistent predominance of male GMs throughout 2015–2021, but also a modest upward trend in female appointments starting in 2018. Staggered DiD estimates show that the reform increased the probability of appointing a female GM by around 11–13 percentage points in the pooled sample, with effects that are particularly pronounced and statistically significant in Recovery Plan regions and not significant elsewhere. This pattern is consistent with the interpretation that legal provisions promoting gender balance in top management positions become more effective where oversight is stronger and appointment procedures are more tightly monitored. At the same time, our analysis does not find clear evidence that these changes in gender composition have yet translated into measurable differences in the economic–financial or clinical indicators we observe, suggesting that the equity and performance dimensions of gender reforms may evolve on different time horizons. This is in line with a growing literature documenting both the potential benefits of women's leadership in health systems and the persistence of structural and organisational barriers that slow down the translation of representation gains into substantive changes in outcomes (Mousa et al., 2021; Kalbarczyk et al., 2025; Baduge et al., 2024).

A further contribution of the paper is to explore how the educational background of GMs relates to clinical performance within the staggered DiD framework. Using Wooldridge's JWDID specification, we investigate whether LHAs governed by clinically trained versus non-clinically trained managers exhibit different trends in 30-day femur mortality. The results reveal an asymmetric pattern: in regions not under the Recovery Plan, LHAs led by GMs with health-related degrees experience a statistically significant post-reform increase in mortality, whereas those headed by non-health GMs do not. Within Recovery Plan regions, by contrast, we do not detect statistically significant differences by educational background. One possible interpretation is that clinically trained managers may be appointed to more complex or fragile organisations, where structural constraints or case-mix composition make short-run improvements in mortality more difficult to achieve. Alternatively, there may be tensions between clinical expertise and the managerial capabilities required to operate within increasingly financialised and regulated environments. Disentangling these mechanisms is a promising avenue for future research.

Despite some caveats, the paper offers several implications for policy and for the broader debate on healthcare governance. First, our findings underscore that formal improvements in transparency and eligibility criteria for top managers are necessary but not sufficient to deliver better performance. The absence of systematic gains in economic–financial outcomes and the modest deterioration in acute mortality suggest that reforms of appointment procedures must be accompanied by adequate support for implementation, clear alignment between managerial incentives and health objectives, and investment in organisational capabilities at multiple levels. Second, the evidence that Recovery Plan regions have shifted towards more managerial, non-clinical leadership profiles without corresponding improvements in clinical performance invites reflection on the balance between financial control and quality of care. In highly constrained settings, an exclusive focus on budgetary metrics may crowd out attention to patient outcomes, unless performance frameworks explicitly reward both dimensions.

Third, the gender results highlight that quotas and gender-balance provisions can alter the composition of leadership, particularly where monitoring and accountability are strong, but that closing representation gaps does not automatically resolve deeper structural barriers. Ensuring that newly appointed female GMs have equal access to resources, support networks, and career opportunities remains essential if gender diversity is to translate into substantive changes in organisational culture and decision-making.

Overall, the study contributes to the growing literature arguing that leadership matters in health-care, but in a way that is context-dependent, institutionally mediated, and far from mechanically determined by formal credentials alone. The Italian case shows that reforms designed to professionalise and standardise managerial selection can change who leads local health systems, but that the translation of these changes into better outcomes depends critically on how managerial skills, clinical expertise, fiscal constraints, and governance arrangements interact on the ground. In line with the view that health systems require a shift from bureaucratic, top-down control to more adaptive forms of management based on collaboration, continuous learning and local innovation (Baker, 2001), our findings suggest that formal changes in eligibility rules need to be complemented by investments in the capabilities of managers to lead change in increasingly complex organisational environments. Future research could extend the analysis to other countries and levels of governance, incorporate richer measures of managerial practices, and explore the dynamic interplay between top management, middle management, and clinical teams. In doing so, it would deepen our understanding of when and how meritocratic, transparent selection of healthcare leaders can deliver on its promise of more efficient, equitable, and high-quality health systems.

B Appendix

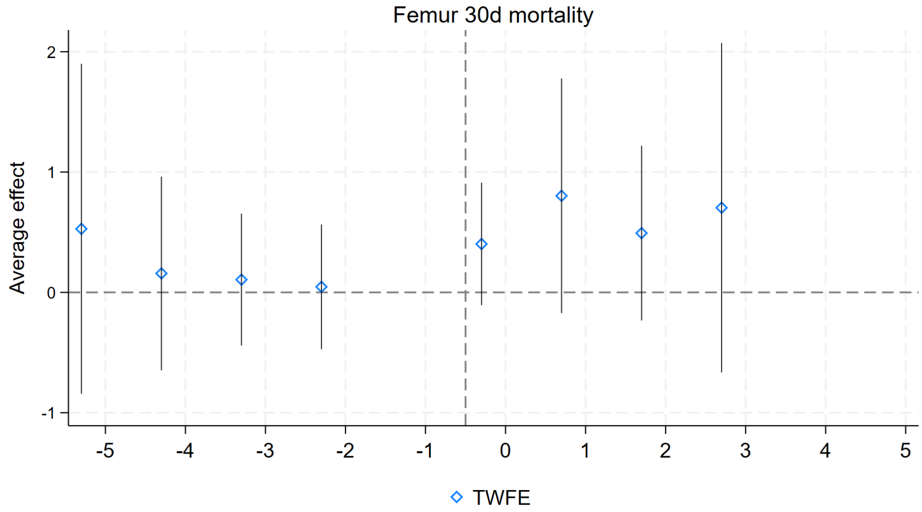
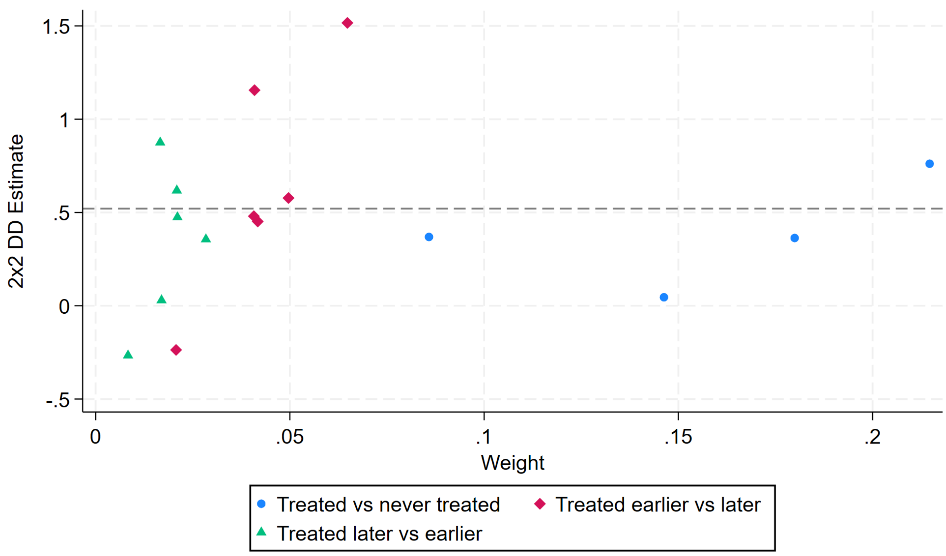


Figure B2: Event study estimates of 30-day femur fracture mortality using the Two Way Fixed Effect model, considering the pooled sample



Treated vs never treated: DD = .4262449 Weight = 0.626736
Treated earlier vs later: DD = .8034912 Weight = 0.258519
Treated later vs earlier: DD = .40847414 Weight = 0.112258

Figure B3: Bacon decomposition of TWFE estimates for Femur 30-day mortality.

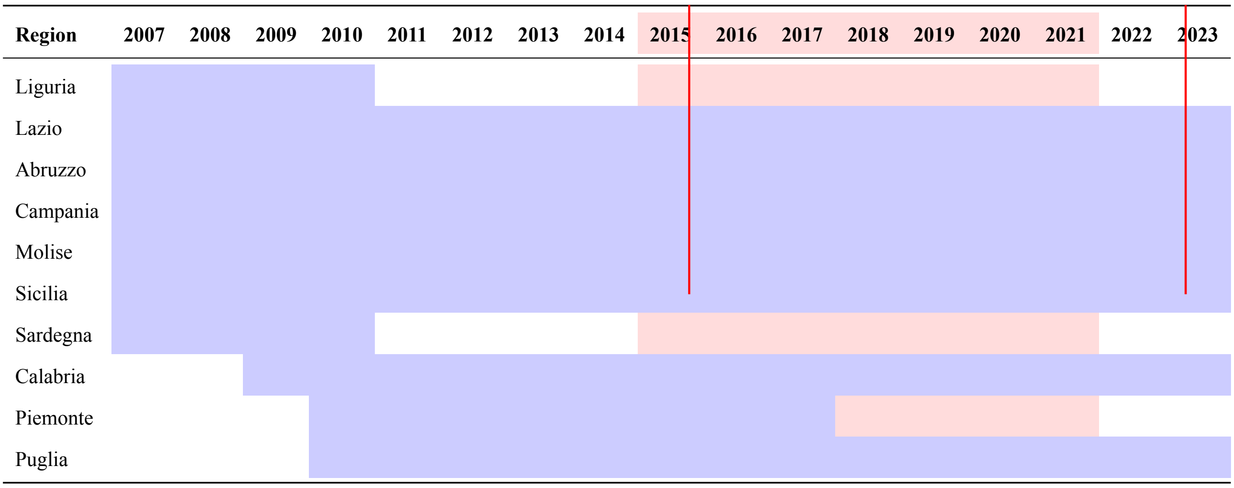


Figure B4: Regions under the recovery plan between 2007 and 2023. Regions not displayed in the table were never involved in recovery plans but are included in the analysis as controls.

Table B3: Callaway & Sant'Anna ATT estimates using the Not-Yet-Treated method for LHAs in regions outside (Panel a) and within (Panel b) the Recovery Plan

Panel a: Callaway and Sant'Anna - Recovery Plan = 0

Outcomes	ATT	S.E.	P-value	PreTrend Test
Operating Margin	0.691	(1.830)	0.705	
Gross Operating Surplus	0.170	(0.641)	0.791	
Financial Viability Index	0.002	(0.002)	0.513	
Revenue-to-Cost Ratio	0.002	(0.002)	0.489	
Patient Mobility	17.224	(21.388)	0.421	
Femur 30d mortality	0.301	(0.380)	0.428	
Hip 30d readmission	0.355	(0.413)	0.390	
Femur surg. $\leq 2d$	-0.377	(2.734)	0.890	
Hip revision $\leq 2y$	0.351	(0.238)	0.141	
Case-Mix-Index	-0.002	(0.002)	0.496	

Panel b: Callaway and Sant'Anna - Recovery Plan = 1

Outcomes	ATT	S.E.	P-value	PreTrend Test
Operating Margin	-1.232	(1.670)	0.461	
Gross Operating Surplus	0.614	(1.037)	0.554	
Financial Viability Index	0.002	(0.005)	0.711	
Revenue-to-Cost Ratio	0.001	(0.005)	0.777	
Patient Mobility	0.418	(0.636)	0.511	
Femur 30d mortality	1.112**	(0.462)	0.016	0.1712
Hip 30d readmission	0.425	(0.470)	0.366	
Femur surg. $\leq 2d$	-2.915	(3.050)	0.339	
Hip revision $\leq 2y$	0.242	(0.409)	0.554	
Case-Mix-Index	-0.001	(0.003)	0.709	

Table B4: Callaway & Sant'Anna ATT estimates using the Never method, comparing the pooled sample (Panel a) and the LHAs in regions outside (Panel b) and within (Panel c) the Recovery Plan

Panel a: Callaway and Sant'Anna, Pooled sample

Outcomes	ATT	S.E	P-value	PreTrend Test
Operating Margin	-0.045	(1.228)	0.971	
Gross Operating Surplus	0.654	(0.530)	0.217	
Financial Viability Index	0.002	(0.002)	0.525	
Revenue-to-Cost Ratio	0.001	(0.002)	0.525	
Patient Mobility	20.862	(25.596)	0.415	
Femur 30d mortality	0.570**	(0.290)	0.049	0.3600
Hip 30d readmission	0.282	(0.280)	0.314	
Femur surg. $\leq 2d$	0.091	(2.065)	0.965	
Hip revision $\leq 2y$	0.267	(0.229)	0.244	
Case-Mix-Index	-0.002	(0.002)	0.417	

Panel b: Callaway and Sant'Anna, Recovery Plan = 0

Outcomes	ATT	S.E	P-value	PreTrend Test
Operating Margin	0.276	(1.794)	0.878	
Gross Operating Surplus	0.103	(0.615)	0.866	
Financial Viability Index	0.000	(0.002)	0.839	
Revenue-to-Cost Ratio	0.001	(0.002)	0.802	
Patient Mobility	25.560	(33.411)	0.444	
Femur 30d mortality	0.261	(0.395)	0.509	
Hip 30d readmission	0.331	(0.436)	0.448	
Femur surg. $\leq 2d$	0.663	(2.706)	0.806	
Hip revision $\leq 2y$	0.370	(0.249)	0.138	
Case-Mix-Index	-0.002	(0.003)	0.457	

Panel c: Callaway and Sant'Anna, Recovery Plan = 1

Outcomes	ATT	S.E	P-value	PreTrend Test
Operating Margin	-1.404	(1.649)	0.394	
Gross Operating Surplus	0.861	(0.843)	0.307	
Financial Viability Index	0.001	(0.004)	0.748	
Revenue-to-Cost Ratio	0.001	(0.003)	0.775	
Patient Mobility	0.698	(0.657)	0.288	
Femur 30d mortality	1.080**	(0.490)	0.027	0.2739
Hip 30d readmission	0.481	(0.516)	0.352	
Femur surg. $\leq 2d$	-4.607	(3.208)	0.151	
Hip revision $\leq 2y$	0.230	(0.395)	0.560	
Case-Mix-Index	-0.001	(0.004)	0.743	

Table B5: Conditional ATT estimates of 30-day femur fracture mortality using the Callaway & Sant'Anna method with the Not-Yet-Treated approach (Pooled sample), under alternative sets of controls.

Outcomes	ATT	S.E	P-value	PreTrend Test
Panel a: controlling for *Average Staff*				
Femur 30d mortality	0.624**	(0.312)	0.046	0.5147
Panel b: controlling for *Average Population*				
Femur 30d mortality	0.585*	(0.326)	0.073	0.7273
Panel c: controlling for *Average Income*				
Femur 30d mortality	0.632**	(0.302)	0.036	0.4195
Panel d: controlling for *Average Population and Staff*				
Femur 30d mortality	0.603*	(0.329)	0.067	0.7153
Panel e: controlling for *Average Income and Staff*				
Femur 30d mortality	0.650**	(0.312)	0.037	0.4064
Panel f: controlling for *Average Population and Income*				
Femur 30d mortality	0.593*	(0.330)	0.072	0.6505
Panel g: controlling for *Average Population, Staff and Income*				
Femur 30d mortality	0.607*	(0.330)	0.066	0.6458

Table B6: Conditional ATT estimates of 30-day femur fracture mortality using the Callaway & Sant'Anna method with the Not-Yet-Treated approach (Recovery plan = 0), under alternative sets of controls.

Outcomes	ATT	S.E	P-value	PreTrend Test
Panel a: controlling for *Average Staff*				
Femur 30d mortality	0.285	(0.392)	0.468	
Panel b: controlling for *Average Population*				
Femur 30d mortality	0.130	(0.388)	0.738	
Panel c: controlling for *Average Income*				
Femur 30d mortality	0.322	(0.414)	0.437	
Panel d: controlling for *Average Population and Staff*				
Femur 30d mortality	0.097	(0.419)	0.818	
Panel e: controlling for *Average Income and Staff*				
Femur 30d mortality	0.311	(0.412)	0.451	
Panel f: controlling for *Average Population and Income*				
Femur 30d mortality	0.304	(0.405)	0.453	
Panel g: controlling for *Average Population, Staff and Income*				
Femur 30d mortality	-0.244	(0.573)	0.670	

Table B7: Conditional ATT estimates of 30-day femur fracture mortality using the Callaway & Sant'Anna method with the Not-Yet-Treated approach (Recovery plan = 1), under alternative sets of controls.

Outcomes	ATT	S.E	P-value	PreTrend Test
Panel a: controlling for *Average Staff*				
Femur 30d mortality	1.252***	(0.471)	0.008	0.0079
Panel b: controlling for *Average Population*				
Femur 30d mortality	1.716***	(0.513)	0.001	0.0288
Panel c: controlling for *Average Income*				
Femur 30d mortality	1.300***	(0.479)	0.007	0.0083
Panel d: controlling for *Average Population and Staff*				
Femur 30d mortality	1.536***	(0.532)	0.004	0
Panel e: controlling for *Average Income and Staff*				
Femur 30d mortality	1.339***	(0.481)	0.005	0.0000
Panel f: controlling for *Average Population and Income*				
Femur 30d mortality	4.249	(2.601)	0.102	
Panel g: controlling for *Average Population, Staff and Income*				
Femur 30d mortality	1.486***	(0.517)	0.004	0.0001

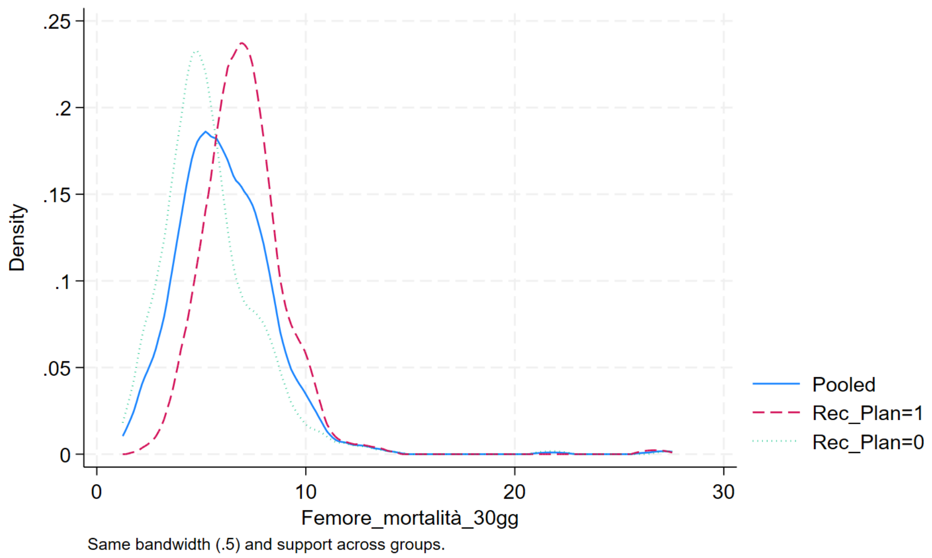


Figure B5: Kernel density distribution of Femur 30d mortality comparing the pooled sample and LHAs in regions under Recovery Plan and not

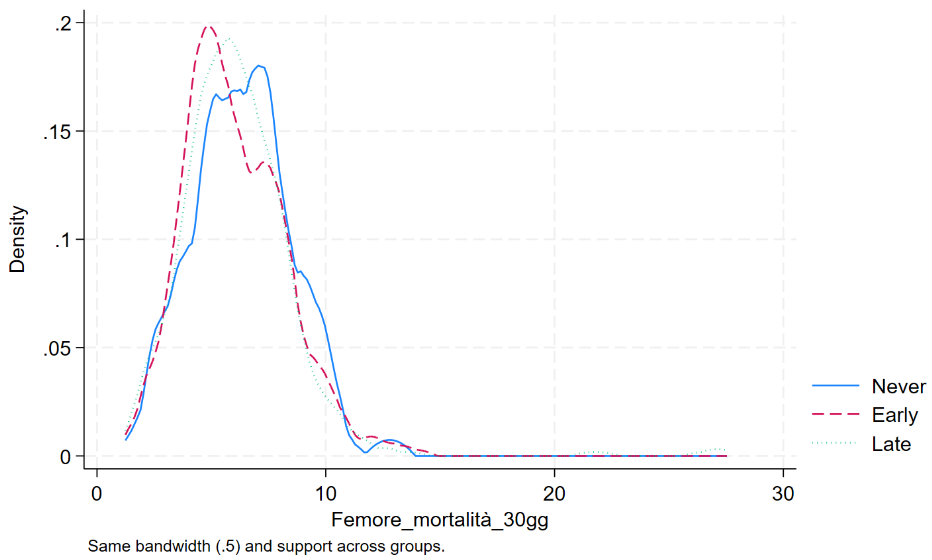


Figure B6: Kernel density distribution of Femur 30d mortality by adoption group

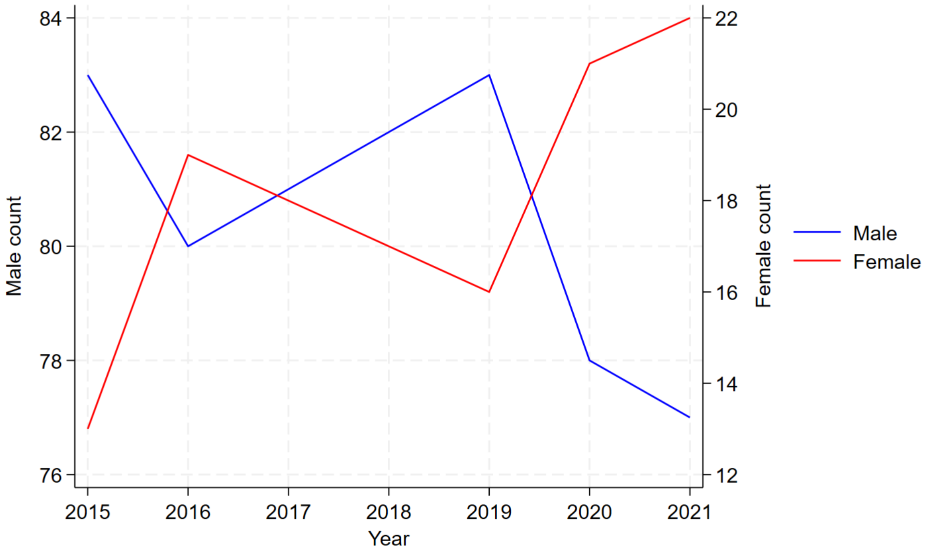
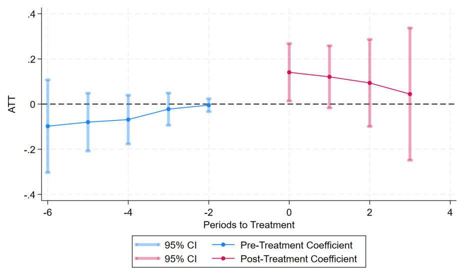
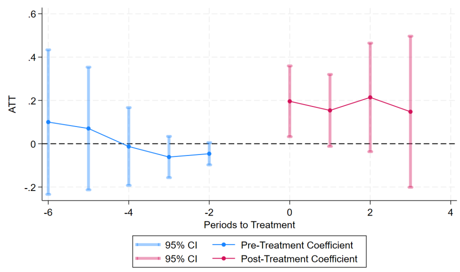


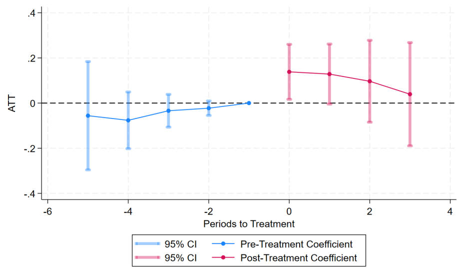
Figure B7: Trends in the number of General Directors by gender – 2015–2021



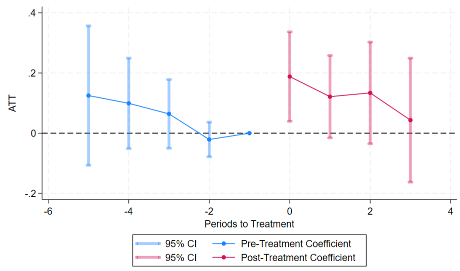
(a) CSDID - *Pooled Sample*



(b) CSDID - *Recovery Plan = 1*



(c) JWDID - *Pooled Sample*



(d) JWDID - *Recovery Plan = 1*

Figure B8: Event study estimates of Female GM Appointment using the (i) Callaway & Sant'Anna model: (a) Pooled sample and (b) LHAs in regions under the recovery plan; (ii) Wooldridge method: (c) Pooled sample and (d) LHAs in regions under the recovery plan.

Table B8: Descriptive statistics

Variable	Mean	SD	Min	Max	N
Economic and Financial Performance					
Operating Margin (EBIT)	5.453	8.244	-12.920	12.031	693
Gross Operating Surplus (EBITDA)	10.133	4.233	-12.388	13.121	693
Revenue-to-Cost Ratio	1.008	0.018	0.860	1.052	693
Financial Viability Index	-0.125	0.113	-0.480	0.071	693
Patient Mobility	24.197	310.361	0.137	7815.125	680
Health and Quality Indicators					
Femur 30d mortality	6.122	2.458	1.242	27.535	686
Hip 30d readmissions	4.616	1.816	0.687	13.487	661
Femur surg. $\leq$ 2d	60.532	18.988	2.257	98.355	686
Hip revision $\leq$ 2y	2.254	1.193	0.330	9.001	593
Case-Mix Index (CMI)	-0.125	0.113	-0.48	0.071	693
Conditional Variables					
Staff	2187.952	1666.112	33	9567	693
Physicians	640.120	475.914	19	2797	693
Nurses	1547.833	1207.171	11	7269	693
Average Income	3.47e+09	8.44e+09	2.25e+08	4.83e+10	693
Average Population	608490.1	470563.4	127226.3	3427613	693

Notes: Means and standard deviations rounded to 3 decimals. N varies due to missing observations.

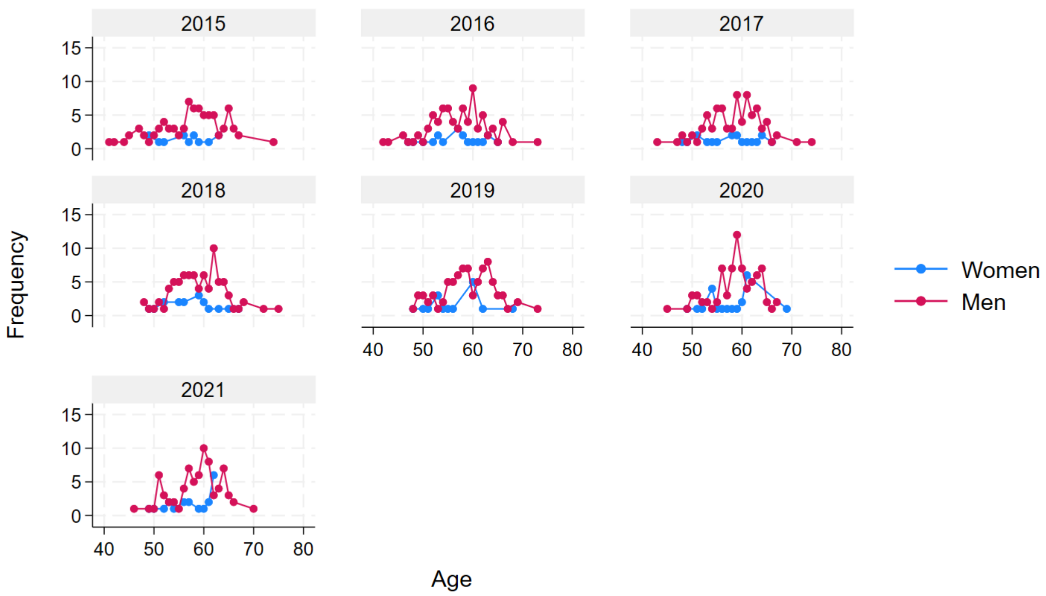


Figure B9: Age distribution of General Managers in the sample by gender for each year over the period 2015–2021.

Table B9: Descriptive statistics by Region under Recovery plan and not

Variable	Mean	SD	Min	Max	N
Recovery plan = 1					
Economic and Financial Performance					
Operating Margin (EBIT)	6.307	7.906	-12.013	11.821	294
Gross Operating Surplus (EBITDA)	10.456	4.025	-10.374	12.684	294
Revenue-to-Cost Ratio	1.009	0.019	0.860	1.052	294
Financial Viability Index					
Patient Mobility	9.616	7.707	0.797	46.172	294
Health and Quality Indicators					
Femur 30d mortality	7.049	2.085	2.535	26.684	294
Hip 30d readmissions	4.860	1.929	0.687	13.487	278
Femur surg. $\leq$ 2d	54.078	22.397	4.034	98.355	294
Hip revision $\leq$ 2y	2.409	1.204	0.792	7.672	220
Case-Mix Index (CMI)	-0.097	0.075	-0.305	0.071	294
Conditional Variables					
Staff	2,069.680	957.799	446	4,681	294
Physicians	670.779	323.521	155	1,556	294
Nurses	1,398.901	649.730	291	3,125	294
Average Income	4.84×10^9	1.22×10^{10}	3.21×10^8	4.83×10^{10}	294
Average Population	577,382.7	331,435.9	156,740.3	1,302,485	294
Recovery plan = 0					
Economic and Financial Performance					
Operating Margin (EBIT)	4.824	8.439	-12.920	12.031	399
Gross Operating Surplus (EBITDA)	9.895	4.370	-12.388	13.121	399
Revenue-to-Cost Ratio	1.007	0.016	0.917	1.045	399
Financial Viability Index					
Patient Mobility	35.302	411.763	0.137	7,815.125	386
Health and Quality Indicators					
Femur 30d mortality	5.427	2.490	1.242	27.535	392
Hip 30d readmissions	4.439	1.711	0.780	10.597	383
Femur surg. $\leq$ 2d	65.373	14.175	2.257	97.400	392
Hip revision $\leq$ 2y	2.163	1.178	0.330	9.001	373
Case-Mix Index (CMI)	-0.145	0.130	-0.480	0.016	399
Conditional Variables					
Staff	2,275.100	2,033.023	33	9,567	399
Physicians	617.529	561.733	19	2,797	399
Nurses	1,657.571	1,481.384	11	7,269	399
Average Income	2.46×10^9	3.49×10^9	2.25×10^8	2.10×10^{10}	399
Average Population	631,411.3	550,352.5	127,226.3	3,427,613	399

Notes: Means and standard deviations rounded to 3 decimals. N varies due to missing observations.

Table B10: Descriptive statistics by adoption group

Variable	Mean	SD	Min	Max	N
Early Adopters					
Economic and Financial Performance					
Operating Margin (EBIT)	7.533	6.092	-10.561	11.277	91
Gross Operating Surplus (EBITDA)	10.923	0.717	7.641	12.533	91
Revenue-to-Cost Ratio	1.013	0.013	0.948	1.041	91
Financial Viability Index	-0.089	0.054	-0.227	0.004	91
Patient Mobility	7.512	6.051	1.103	23.406	91
Health and Quality Indicators					
Femur 30d mortality	6.359	2.138	1.884	12.792	91
Hip 30d readmissions	4.574	2.045	0.687	8.950	88
Femur surg. $\leq$ 2d	61.986	16.762	13.210	98.355	91
Hip revision $\leq$ 2y	2.535	1.518	0.386	7.581	78
Case-Mix Index (CMI)	-0.089	0.054	-0.227	0.004	91
Never Adopters					
Economic and Financial Performance					
Operating Margin (EBIT)	7.031	7.014	-11.210	11.821	231
Gross Operating Surplus (EBITDA)	10.476	3.729	-9.421	12.765	231
Revenue-to-Cost Ratio	1.011	0.012	0.959	1.045	231
Financial Viability Index	-0.133	0.130	-0.425	0.064	231
Patient Mobility	49.730	535.231	0.137	7815.125	224
Health and Quality Indicators					
Femur 30d mortality	6.005	2.180	1.242	13.754	226
Hip 30d readmissions	4.607	1.922	0.780	13.487	223
Femur surg. $\leq$ 2d	63.302	17.015	4.688	95.523	226
Hip revision $\leq$ 2y	2.161	1.048	0.366	7.784	200
Case-Mix Index (CMI)	-0.133	0.130	-0.425	0.064	231
Late Adopters					
Economic and Financial Performance					
Operating Margin (EBIT)	3.961	9.091	-12.920	12.031	371
Gross Operating Surplus (EBITDA)	9.725	4.934	-12.388	13.121	371
Revenue-to-Cost Ratio	1.004	0.020	0.860	1.052	371
Financial Viability Index	-0.129	0.111	-0.480	0.071	371
Patient Mobility	12.684	59.702	0.729	807.994	365
Health and Quality Indicators					
Femur 30d mortality	6.136	2.684	1.411	27.535	369
Hip 30d readmissions	4.633	1.687	0.991	10.755	350
Femur surg. $\leq$ 2d	58.477	20.393	2.257	97.400	369
Hip revision $\leq$ 2y	2.244	1.181	0.330	9.001	315
Case-Mix Index (CMI)	-0.129	0.110	-0.48	0.071	371

Notes: Means and standard deviations rounded to 3 decimals. N varies due to missing observations.

Table B11: List of Local Health Authorities

Local Health Authorities	
ASL Città di Torino	Azienda Sanitaria Locale della provincia di Taranto
ASUR Marche	Azienda Sanitaria Locale n. 1 Avezzano–Sulmona–L'Aquila
Agenzia di Tutela della Salute Brianza	Azienda Sanitaria Locale n. 2 Lanciano–Vasto–Chieti
Agenzia di Tutela della Salute Città Metropolitana di Milano	Azienda Sanitaria Locale n. 3 Pescara
Agenzia di Tutela della Salute Insubria	Azienda Sanitaria Locale n. 4 Teramo
Agenzia di Tutela della Salute Montagna	Azienda Sanitaria Provinciale Agrigento
Azienda Provinciale per i Servizi Sanitari della Provincia Autonoma di Trento	Azienda Sanitaria Provinciale Caltanissetta
Azienda Sanitaria Friuli Occidentale	Azienda Sanitaria Provinciale Catania
Azienda Sanitaria Locale AL	Azienda Sanitaria Provinciale Catanzaro
Azienda Sanitaria Locale AT (ex Asti n. 19)	Azienda Sanitaria Provinciale Cosenza
Azienda Sanitaria Locale Aosta	Azienda Sanitaria Provinciale Crotone
Azienda Sanitaria Locale Avellino	Azienda Sanitaria Provinciale Enna
Azienda Sanitaria Locale BI (ex Biella n. 12)	Azienda Sanitaria Provinciale Messina
Azienda Sanitaria Locale Benevento	Azienda Sanitaria Provinciale Palermo
Azienda Sanitaria Locale CN1	Azienda Sanitaria Provinciale Ragusa
Azienda Sanitaria Locale CN2 (ex Alba n. 18)	Azienda Sanitaria Provinciale Reggio Calabria
Azienda Sanitaria Locale Caserta	Azienda Sanitaria Provinciale Siracusa
Azienda Sanitaria Locale Frosinone	Azienda Sanitaria Provinciale Trapani
Azienda Sanitaria Locale Latina	Azienda Sanitaria Provinciale Vibo Valentia
Azienda Sanitaria Locale Matera	Azienda Sanitaria Regionale Molise
Azienda Sanitaria Locale NO (ex Novara n. 13)	Azienda Sanitaria Universitaria Friuli Centrale (ASU FC)
Azienda Sanitaria Locale Napoli 1 Centro	Azienda Sanitaria Universitaria Giuliano Isontina (ASU GI)
Azienda Sanitaria Locale Napoli 2 Nord	Azienda Sanitaria della Provincia Autonoma di Bolzano
Azienda Sanitaria Locale Napoli 3 Sud	Azienda Sociosanitaria Ligure 1 (ex ASL n. 1 Imperiese)
Azienda Sanitaria Locale Potenza	Azienda Sociosanitaria Ligure 2 (ex ASL n. 2 Savonese)
Azienda Sanitaria Locale Provincia di Bergamo	Azienda Sociosanitaria Ligure 3 (ex ASL n. 3 Genovese)
Azienda Sanitaria Locale Provincia di Brescia	Azienda Sociosanitaria Ligure 4 (ex ASL n. 4 Chiavarese)
Azienda Sanitaria Locale Provincia di Mantova	Azienda Sociosanitaria Ligure 5 (ex ASL n. 5 Spezzino)
Azienda Sanitaria Locale Provincia di Pavia	Azienda ULSS n. 1 Dolomiti (ex ULSS n. 1 Belluno)
Azienda Sanitaria Locale Rieti	Azienda ULSS n. 2 Marca Trevigiana (ex ULSS n. 9 Treviso)
Azienda Sanitaria Locale Roma 1	Azienda ULSS n. 3 Serenissima (ex ULSS n. 12 Veneziana)
Azienda Sanitaria Locale Roma 2	Azienda ULSS n. 4 Veneto Orientale (ex ULSS n. 10 Veneto Orientale)
Azienda Sanitaria Locale Roma 3 (ex RM/D)	Azienda ULSS n. 5 Polesana (ex ULSS n. 18 Rovigo)
Azienda Sanitaria Locale Roma 4 (ex RM/F)	Azienda ULSS n. 6 Euganea (ex ULSS n. 16 Padova)
Azienda Sanitaria Locale Roma 5 (ex RM/G)	Azienda ULSS n. 7 Pedemontana (ex ULSS n. 3 Bassano del Grappa)
Azienda Sanitaria Locale Roma 6 (ex RM/H)	Azienda ULSS n. 8 Berica (ex ULSS n. 6 Vicenza)
Azienda Sanitaria Locale Salerno	Azienda ULSS n. 9 Scaligera (ex ULSS n. 20 Verona)
Azienda Sanitaria Locale TO3	Azienda USL Bologna
Azienda Sanitaria Locale TO4	Azienda USL Ferrara
Azienda Sanitaria Locale TO5 (ex Chieri n. 8)	Azienda USL Imola
Azienda Sanitaria Locale VC (ex Vercelli n. 11)	Azienda USL Modena
Azienda Sanitaria Locale VCO (ex Omegna n. 14)	Azienda USL Parma
Azienda Sanitaria Locale Viterbo	Azienda USL Piacenza
Azienda Sanitaria Locale della provincia di Bari	Azienda USL Reggio Emilia
Azienda Sanitaria Locale della provincia di Barletta–Andria–Trani	Azienda USL Umbria n. 1
Azienda Sanitaria Locale della provincia di Brindisi	Azienda USL Umbria n. 2
Azienda Sanitaria Locale della provincia di Foggia	Azienda USL della Romagna
Azienda Sanitaria Locale della provincia di Lecce	Azienda Unità Sanitaria Locale Toscana Centro
Azienda Sanitaria Locale della provincia di Taranto	Azienda Unità Sanitaria Locale Toscana Nord Ovest
Azienda Unità Sanitaria Locale Toscana Sud Est	Azienda per la Tutela della Salute (ex ASL n. 1 Sassari)

Women										
	Year							Totals		
Field of study	2015	2016	2017	2018	2019	2020	2021	2015–2017	2018–2021	2015–2021
Medicine	53.8	42.1	44.4	41.2	31.2	42.9	31.8	46.0	36.8	40.5
Health Courses	0.0	0.0	0.0	5.9	6.2	4.8	4.5	0.0	5.3	3.2
Law	23.1	15.8	16.7	17.6	31.2	19.0	27.3	18.0	23.7	21.4
Engineering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Economics	15.4	21.1	16.7	17.6	18.8	23.8	27.3	18.0	22.4	20.6
Others	7.7	21.1	22.2	17.6	12.5	9.5	9.1	18.0	11.8	14.3
Health-related fields	53.8	42.1	44.4	47.1	37.5	47.6	36.4	46.0	42.1	43.7
Other fields	46.2	57.9	55.6	52.9	62.5	52.4	63.6	54.0	57.9	56.3
Men										
	Year							Totals		
Field of study	2015	2016	2017	2018	2019	2020	2021	2015–2017	2018–2021	2015–2021
Medicine	59.0	59.5	63.8	63.4	60.2	55.1	54.5	59.1	56.2	57.5
Health Courses	2.4	1.3	1.2	2.4	1.2	1.3	3.9	1.7	2.2	2.0
Law	15.7	17.7	15.0	15.9	19.3	16.7	14.3	16.1	16.6	16.4
Engineering	3.6	5.1	5.0	4.9	7.2	9.0	10.4	4.5	7.8	6.4
Economics	15.7	13.9	12.5	13.4	9.6	15.4	15.6	14.0	13.4	13.7
Others	6.0	3.8	3.8	2.4	3.6	3.8	5.2	4.5	3.8	4.1
Health-related fields	59.0	59.5	63.8	63.4	60.2	55.1	54.5	60.7	58.4	59.4
Other fields	41.0	40.5	36.2	36.6	39.8	44.9	45.5	39.3	41.6	40.6

Table B12: Distribution of university degrees among general managers of local health authorities (LHAs) by gender, year and period. All entries are expressed as percentages; the last three columns report average shares for 2015–2017, 2018–2021, and the full 2015–2021 period.

B.1 Staggered DiD (jwdid / Wooldridge)

The *jwdid* estimator is a flexible difference-in-differences framework for staggered adoption that generalizes two-way fixed-effects by allowing cohort-by-time treatment effects and by supporting nonlinear models (e.g., logit), following Wooldridge's ETWFE logic and recent implementations by Rios-Avila (2025). In its linear form, *jwdid* replaces the single post-treatment coefficient with a full set of group–time parameters θ_{gt}:

$$y_{it} \;=\; \beta_i + \lambda_t \;+\; \sum_{g} \sum_{t \geq g} \theta_{gt}\, \mathbf{1}\{G_i = g,\, t\} \;+\; \varepsilon_{it}, \tag{3.5}$$

so that identification uses *not-yet-treated* units as valid controls in each period and effect heterogeneity over cohorts and calendar time is explicit. *jwdid* thus avoids the negative-weight/incorrect-control issues of TWFE when effects are heterogeneous over time and groups.

With staggered adoption and the usual "once treated, always treated" convention, the target is a set of cohort–time effects $\text{ATT}(g,t)$ for $t \geq g$, each comparing outcomes of cohort g in period t to the counterfactual built from units not yet exposed at t. Under no anticipation and (conditional) parallel trends, the post-treatment ATT is recovered from the model above; *jwdid* also allows explicit *pre-treatment* coefficients to test for pre-trends (parallel trends), including an option to use *never-treated* as the comparison group when conducting formal tests.

A key advantage is flexible conditioning. *jwdid* accommodates covariates X_{it} either (i) via "demeaned" interactions so that θ_{gt} directly maps into $\text{ATT}(g,t)$, or (ii) "as is" (*xasis*), in which case θ_{gt} lives on the regression index and ATT aggregation is obtained via post-estimation predictions. This setup naturally implements conditional parallel trends (CPTA) and permits rich X-heterogeneity without imposing constant treatment effects across subgroups.

Unlike standard linear csdid implementations, *jwdid* natively supports nonlinear links through *method()*; for a binary outcome one can estimate *logit* ETWFE with cohort fixed effects (or correlated random effects, *cre*) to address incidental-parameters concerns. Aggregat. This is particularly useful when the estimand of interest is a probability rather than a mean in levels.

Both csdid and jwdid identify ATT(g, t) using not-yet-treated units period-by-period under (conditional) parallel trends and no anticipation. In practice, csdid is typically implemented in linear models with time-invariant (pre-period) covariates, whereas *jwdid* extends to nonlinear links (e.g., logit) and offers broader ways to handle covariates and heterogeneity, plus built-in pre-trend testing within the same unified specification. In settings like ours—with a binary managerial background outcome and interest in dynamic probabilities—these features motivate our complementary use of *jwdid*.

B.2 PNE Risk Adjustment Methodology

In this study, hospital outcome data are risk-adjusted using the standardized methodology of the National Outcomes Program (PNE). Since comparative evaluations in observational studies must account for heterogeneity in patient populations (e.g., by age, gender, severity of the pathology, and comorbidities), these factors can act as confounders. The PNE's risk adjustment procedure is designed to neutralize this effect, allowing for a comparison of provider performance "net" of the potential confounding effect of the different distribution of patient characteristics. The methodological process involves two main phases. First, a predictive model is constructed using multivariate regression to estimate the relationship between risk factors (predictors) and the outcome, thereby building a specific measure of severity. The statistical tool varies based on the nature of the outcome:

1. For dichotomous outcome variables (e.g., mortality yes/no), the PNE uses logistic regression models. In these models, the log-odds of the outcome (πi) is expressed as a linear combination of the predictors (X_{ki}):

$$log[\pi i/(1-\pi i)] = \beta_0 + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{ki}\beta_k$$

2. For outcomes expressed as time (e.g., survival or waiting time), survival models are used, such as the Cox model (if hazards are proportional). The log-transformed hazard rate ($\lambda(t_i)$) is modeled as:

$$log[\lambda(t_i)] = log[\lambda_0(t)] + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{ki}\beta_k$$

3. For population-based indicators, Poisson regression models are employed. In this case, the log-transformed outcome rate (t_i) is expressed as:

$$log(t_i) = \beta_0 + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{ki}\beta_k$$

Second, once the severity measure is constructed, the risks of each provider are compared using the direct standardization method. This procedure calculates the expected risks for each hospital as if all hospitals had the exact same patient distribution (by age, sex, severity, and comorbidity) as the ”general population” of reference.

Finally, it is relevant to note that the PNE exclusively uses ”fixed-effects” models for comparisons between providers. This choice is adopted to avoid the biased estimates that would be produced by ”random-effects” (or multilevel) models. The latter, in fact, ”shrink” the estimates of each hospital toward the overall mean (the so-called shrinkage effect), thereby presenting the performance of worse-performing providers too positively and that of better-performing providers too negatively, consequently altering the rankings.

B.3 Descriptive Analysis

This subsection investigates two questions: (i) whether the Legislative Decree affected the selection of General Managers as a function of their educational background (field of degree); and (ii) whether, under Wooldridge’s estimator for staggered DiD, the education of General Managers correlates with the short-run clinical performance of Local Health Authorities.

Figure B10 provides descriptive evidence on the educational background of General Managers

(GMs) before and after 2018, distinguishing Local Health Authorities (LHAs) in regions not subject to the Recovery Plan (Recovery Plan = 0) from those in regions under the Recovery Plan (Recovery Plan = 1). For LHAs outside the Recovery Plan, the share of GMs with a health-related degree (Medicine, Nursing and Midwifery, Biology, Hygiene, Nursing Sciences, Psychology, Pharmacy, etc.) slightly increases after 2018 (from about 59% to about 62%), while the share of GMs with non-health degrees (Law, Engineering, Economics, Political Science, etc.) slightly decreases (from about 41% to about 38%). In other words, outside Recovery Plan regions we do not observe a structural break: LHAs continue to appoint GMs predominantly with health-sector training.

In contrast, for LHAs in regions under the Recovery Plan we observe a clear reversal. Before 2018, a majority of GMs held a health-related degree (around 55%), while only about 41% came from non-health fields. After 2018, these shares essentially invert: the share of GMs with a health-related degree falls (to around 46%), whereas the share with non-health degrees rises above 53%. This suggests that, following the introduction of the national eligibility list and the tightening of appointment rules, Recovery Plan regions increasingly appointed GMs with legal, economic, administrative, or technical-managerial backgrounds, and relatively fewer GMs with strictly clinical or health-related backgrounds. This shift is not visible in regions outside the Recovery Plan.

Figure B14 translates the patterns documented in Figure B10 into a region-level map, offering a more granular view of the relative percentage change (2018 onward vs. pre-2018) in the share of appointees with non-health degrees. The spatial distribution makes clear that this phenomenon is more pronounced in recovery-plan regions, thereby reinforcing the descriptive evidence in Figure B10.

Since this descriptive pattern is suggestive but not causal, we then estimate a difference-in-differences model to assess whether the Legislative Decree is associated with a systematic change in the composition of GM profiles in Recovery Plan regions. The outcome of interest is a binary indicator:

$$\text{Degree}_{it} = \begin{cases} 1 & \text{if the GM of LHA } i \text{ in year } t \text{ has a non-health-related degree,} \\ 0 & \text{if the GM has a health-related degree.} \end{cases}$$

Substantively, we ask whether, after the reform becomes effective, the probability that an LHA (in particular, an LHA in a Recovery Plan region) is headed by a GM with a non-health educational background increases relative to the counterfactual evolution of not-yet-treated LHAs.

The corresponding event-study estimates are reported in Figure B11. The pre-treatment coefficients (in blue) fluctuate around zero and do not display a pronounced upward trend prior to treatment. This is consistent not only visually with the parallel-trends requirement, but also statistically, as shown in Table B13: the formal pre-trend test yields a p-value of 0.4584, so we do not reject parallel trends before adoption. After treatment (in red), the coefficients become positive and remain at elevated levels in subsequent periods. Substantively, this indicates that, once the reform becomes operative, the likelihood that an LHA is led by a General Manager with a non-health degree increases and tends to persist over time. The effect is concentrated in Recovery-Plan regions, where ATT estimates are positive and statistically significant (0.275 p.p., ρ = 0.042), while no significant change is detected in non-Plan regions. Although confidence intervals widen in later post-treatment periods, the post-reform trajectory remains consistently upward, mirroring the descriptive break observed in Figure B10 for Recovery-Plan regions. The robustness of this pattern will be further assessed in the following subsection using an alternative estimator.

Taken together, the descriptive evidence and the event-study results point in the same direction. First, after 2018 there is a systematic shift in managerial profiles in LHAs located in Recovery Plan regions: they appoint relatively more GMs with non-health degrees and fewer with health-related degrees. Second, this shift does *not* occur in LHAs outside the Recovery Plan. This is consistent with the interpretation that the Legislative Decree interacted with the tighter governance and financial-discipline environment already in place under the Recovery Plan, pushing those regions toward a more managerial conception of the GM role (emphasizing administrative, financial, and coordination skills rather than exclusively clinical expertise).

Table B13: ATT estimates of the Reform's Impact on the Appointment of General Managers by Educational Background using the Callaway and Sant'Anna model and the Wooldridge method, with the Not-Yet-Treated approach, comparing the pooled sample (Panel a) and the LHAs in regions outside (Panel b) and within (Panel c) the Recovery Plan.

	Callaway and Sant'Anna				**JWDID**			
Outcomes	ATT	S.E.	P-value	PreTrend Test	ATT	S.E.	P-value	PreTrend Test
Panel a: Pooled Sample								
Degree	0.084	(0.097)	0.386		0.143	(0.096)	0.134	
Panel b: Recovery Plan = 0								
Degree	-0.114	(0.131)	0.385		-0.026	(0.128)	0.834	
Panel c: Recovery Plan = 1								
Degree	0.275**	(0.135)	0.042	0.4584	0.310**	(0.132)	0.019	0.5607

As a robustness check, we extend the analysis by applying the estimator proposed by Wooldridge,[4] which accommodates nonlinear specifications such as logit. This approach is particularly suitable for our setting, where the outcome is binary, as it allows us to estimate a staggered difference-in-differences in probabilities rather than levels, without imposing a linear probability model. The event-study estimates from Wooldridge's specification are reported in Figure B12, and the corresponding ATT estimates are summarized in Table B13. The dynamic pattern is fully consistent with the Callaway and Sant'Anna results: after the reform becomes effective, the probability that an LHA is headed by a General Manager with a non-health-degree background increases and remains persistently higher in the post-treatment period, particularly in Recovery-Plan regions. The effect is concentrated in these regions, where the ATT is positive and statistically significant (0.310 p.p., $p = 0.019$), while no significant changes are observed in non-Plan regions or in the pooled sample. The pre-trend tests continue to support the parallel-trends assumption

[4] We use the `jwdid` package to estimate Wooldridge's model in Stata 18.

($\rho = 0.5607$), confirming that the observed shift is unlikely to be driven by pre-existing differences across LHAs.

Relative to the Callaway and Sant'Anna estimates, Wooldridge's coefficients tend to be more precisely estimated and, in several post-reform periods, achieve stronger levels of statistical significance. This improvement in precision reflects the methodological advantage of the nonlinear framework, which models the binary outcome directly in probabilities rather than levels. Substantively, the results reinforce the interpretation that, following the 2018 reform, Recovery-Plan regions underwent a marked shift in managerial composition—away from clinically trained General Managers and toward those with administrative, legal, or economic backgrounds. No comparable pattern is detected in regions not subject to the Recovery Plan, where post-treatment coefficients remain close to zero and statistically insignificant. Taken together, the consistency in magnitude, timing, and direction across both estimators strongly supports the robustness of the main finding: the reform interacted with the more stringent governance and accountability framework already in place under the Recovery Plan, accelerating a transition toward more managerial and less clinical leadership profiles within LHAs.

Finally, exploiting the flexibility of Wooldridge's framework, we also examine whether this managerial shift is associated with downstream differences in health performance. Specifically, we use the type of degree of the General Manager (health-related vs. non-health-related) as a covariate to study its association with our main clinical outcome (30-day mortality after femoral neck fracture). This additional exercise delivers an interesting asymmetry. We find a statistically significant effect in LHAs located in regions *not* under the Recovery Plan: worse health performance (higher post-operative 30-day mortality) is observed when LHAs are led by General Managers with a predominantly health-sector educational background. By contrast, this effect is not statistically significant in Recovery-Plan regions. In other words, conditional on our controls, the presence of a clinically trained General Manager is associated with an adverse mortality profile only outside the Recovery Plan, whereas within the Plan we do not detect a differential effect of managerial background on short-run mortality.

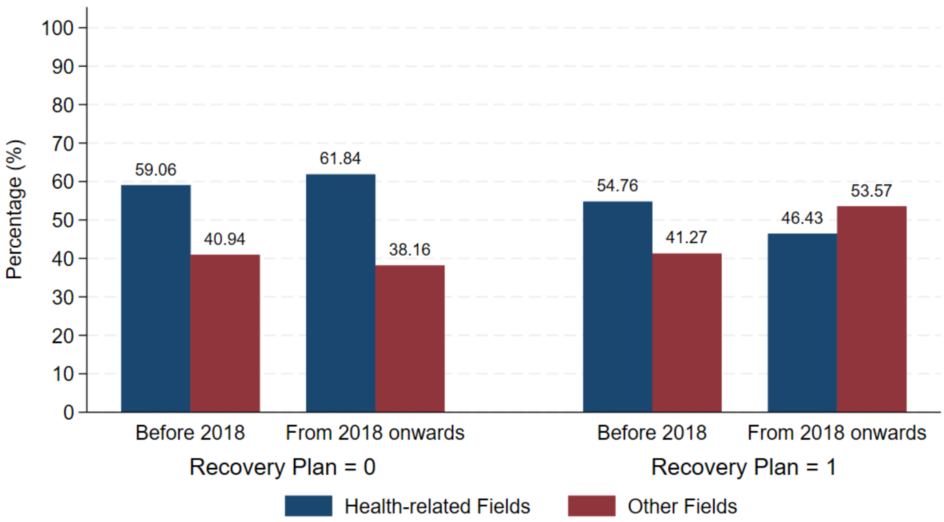
More detailed estimates are reported in Table B14.

In the pooled sample (Panel a), we find no statistically significant effect for LHAs led by GMs with non-health backgrounds (Degree = 1). By contrast, for LHAs led by GMs with a health-related background (Degree = 0), the estimated effect is both large and statistically significant: the ATT is 1.142. The sign is *positive*, which in our context implies a deterioration in health performance. The associated pre-trend test does not reject parallel trends ($\rho = 0.5570$), which supports the internal validity of this comparison.

Panel b shows that this pattern is already visible in LHAs located in regions *not* under the Recovery Plan. For LHAs led by GMs with non-health degrees (Degree = 1), the estimated ATT is again small and not statistically different from zero. However, for LHAs led by GMs with health-related degrees (Degree = 0), we estimate an ATT of approximately 1.006 and a ρ-value of 0.029. This confirms, within non-Recovery-Plan regions, that mortality increases after the reform specifically where the LHA is headed by a clinically trained GM. The pre-trend test again does not reject parallel trends ($\rho = 0.8301$), which lends credibility to the causal interpretation in this subsample.

Panel c focuses on LHAs in regions *under* the Recovery Plan. Here, neither subgroup reaches conventional statistical significance.

Overall, two conclusions emerge. First, we do *not* detect any worsening in short-run clinical performance when LHAs are led by GMs with non-health (managerial/administrative) degrees: across all panels, the corresponding ATTs are small and never statistically significant. Second, worse clinical performance is concentrated in LHAs led by GMs with a health-related degree. This effect is statistically significant in the pooled sample and in regions outside the Recovery Plan, and it satisfies the parallel-trends diagnostic in those cases. Within Recovery-Plan regions the point estimates go in the same (unfavorable) direction for health-trained GMs, but with wider



Degrees in health-related fields: Medicine, Nursing and Midwifery, Biology, Hygiene, Nursing Sciences, Psychology, and Pharmacy
Degrees in other fields: Law, Engineering, Computer Science, Economics, Sociology, Political Science, Philosophy, Physics, Agricultural Sciences, Mathematical Sciences, Humanities

Figure B10: Percentage of Degrees in Health-related and Other Fields, Before and After 2018, by Recovery Plan

confidence intervals. In this sense, the Wooldridge's model results reinforce the interpretation that the post-reform deterioration in mortality is not uniform: it is strongest, most precisely estimated, and most clearly identifiable where LHAs are managed by clinically trained General Managers, particularly outside the Recovery Plan.

Table B14: Conditional ATT estimates of 30-day femur fracture mortality using the Wooldridge method with the Not-Yet-Treated approach, comparing the pooled sample (Panel a) and the LHAs in regions outside (Panel b) and within (Panel c) the Recovery Plan.

	Degree = 1				Degree = 0			
Outcomes	ATT	S.E	P-value	PreTrend Test	ATT	S.E	P-value	PreTrend Test
Panel a: JWDID, Pooled Sample								
Femur 30d mortality	0.100	(0.400)	0.802		1.142**	(0.454)	0.012	0.5570
Panel b: JWDID, Recovery Plan = 0								
Femur 30d mortality	0.327	(0.461)	0.478		1.006**	(0.461)	0.029	0.8301
Panel c: JWDID, Recovery Plan = 1								
Femur 30d mortality	0.278	(0.555)	0.617		1.384	(0.890)	0.120	

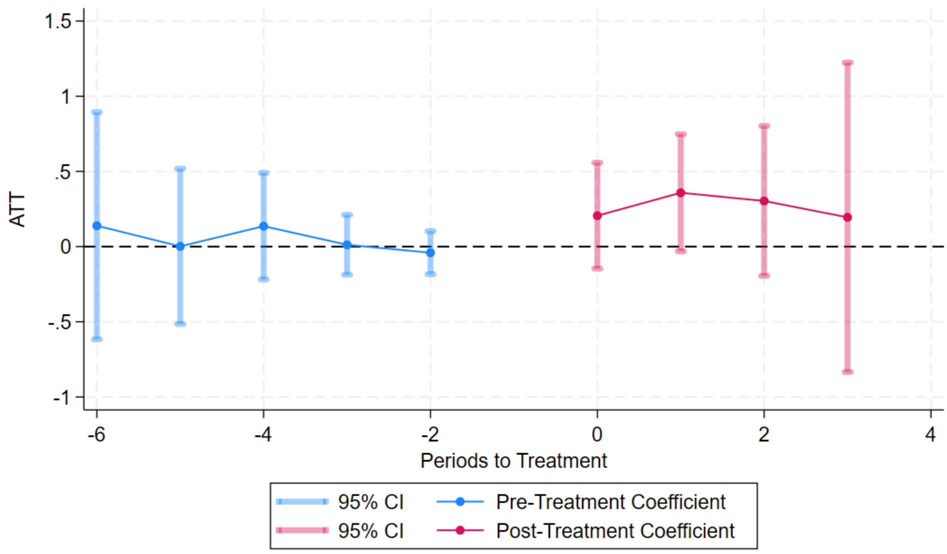


Figure B11: Event study estimate of the ATT (pp) on the indicator that the appointed General Manager holds a non-health degree in region under recovery plan, using the Callaway & Sant'Anna model.

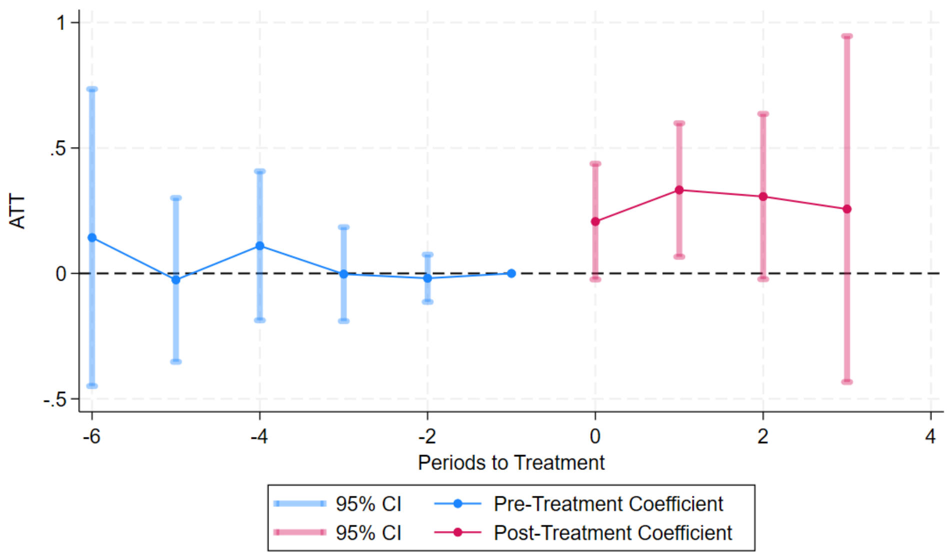


Figure B12: Event study estimate of the probability that the appointed General Manager holds a non-health degree in region under recovery plan, using the Wooldridge model.

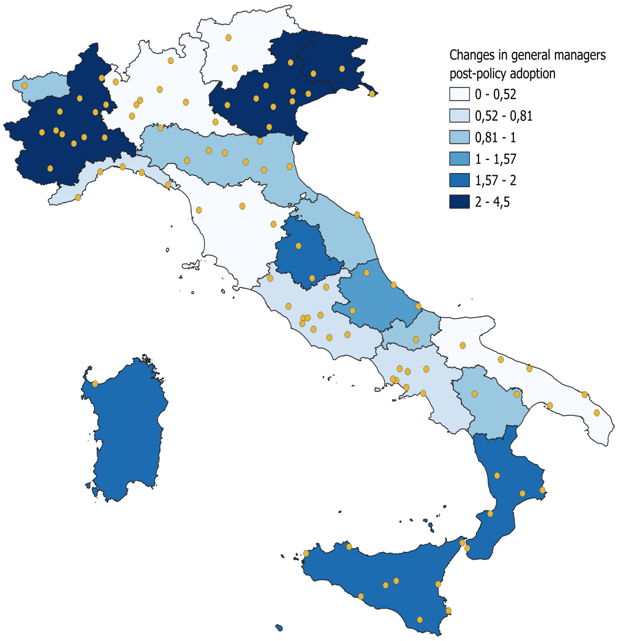


Figure B13: Variation in the turnover of General Directors relative to the number of local health authorities (LHAs) in each region, following the adoption of the policy. Yellow dots indicate the geographic location of individual LHAs in Italy in 2021.

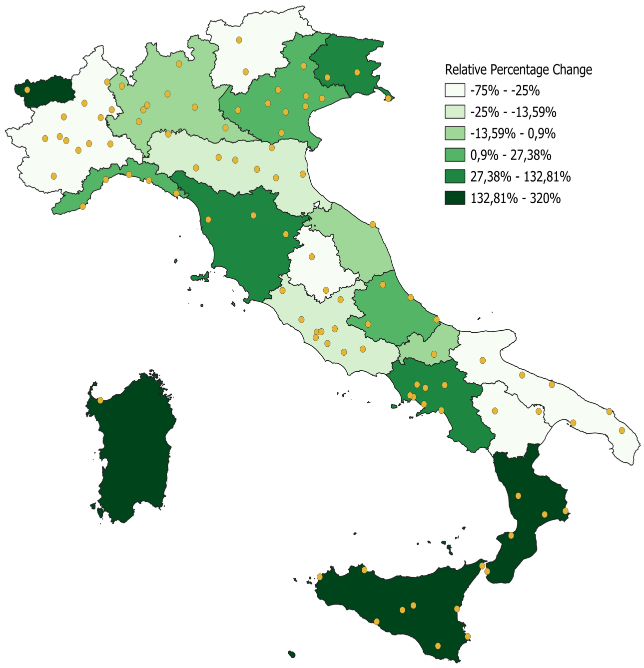


Figure B14: Relative percentage change in the share of managers with non-health degrees, comparing 2018 onward with pre-2018. Yellow dots indicate the geographic location of individual LHAs in Italy in 2021.

To complement the anlysis evidence with a spatial perspective on the managerial channel, Figure B13 displays a choropleth of post-policy General-Director turnover, normalized by the number of LHAs per region, thereby revealing where leadership changes were most pronounced. Darker shades indicate higher replacement rates following the reform. The pattern is spatially heterogeneous: several southern regions and the major islands display comparatively higher turnover, whereas parts of the Center–North exhibit moderate values with a few high-turnover outliers. The distribution of LHA dots within regions also signals within-region dispersion, suggesting that policy implementation and managerial mobility did not evolve uniformly across local markets.

Finally, we complement the descriptive analysis by focusing on the gender dimension of top management. This subsection documents how the representation of women in General Director positions has evolved over time and assesses to what extent the 2016 reform promoting gender balance in top management has effectively increased the likelihood of appointing female General Managers (GMs).

Figure B7 illustrates the evolution of the number of General Directors over the period 2015–2021, disaggregated by gender. A clear predominance of male directors is observed throughout the period, with values ranging between 76 and 84, whereas the number of female directors varies between 12 and 22. Nevertheless, starting from 2018, a modest but noticeable increase in female appointments emerges, coinciding with the introduction of the legislative decree promoting gender balance in top management positions.

This pattern is substantiated by the econometric evidence reported in Table B15, which details the Average Treatment effect on the Treated (ATT) of the 2016 reform on the propensity to appoint female General Managers (GMs). The analysis employs the Callaway and Sant'Anna (2021) and the Wooldridge (2021) *jwdid* approach. The latter is adopted because it allows the implementation of a Logit specification, which is more appropriate for modelling the binary dependent variable.

The results for the Pooled Sample (Panel a) show a positive and statistically significant coefficient across both models. The Wooldridge model yields an ATT of 0.130 ($\rho = 0.028$), indicating that the reform increased the likelihood of a female GM appointment by approximately 13 percentage points. The C&S model corroborates this with a similar ATT of 0.117 ($\rho = 0.080$). Crucially, the validity of these estimates is supported by the pre-trend tests, which report high p-values (0.5951 and 0.6293, respectively), confirming that the parallel trends assumption is met.

The analysis of heterogeneity across regions yields further insights. The effect appears concentrated in regions subject to a Recovery Plan (Panel c). Here, the C&S estimator finds a large and significant effect (ATT: 0.182, $\rho = 0.039$), while the JWDID estimate is also significant at the 10% level (ATT: 0.123, $\rho = 0.091$). Conversely, in non-Recovery Plan regions (Panel b), the coefficients remain positive but are not statistically significant in either specification.

This aggregate impact is further visualised in the corresponding event study plots (see Appendix, Figure B8). The event studies confirm the absence of pre-reform divergence and illustrate a clear, positive structural break in the trend immediately following the reform, affirming a heightened propensity to select female GMs post-2018. As shown in all four panels, the pre-treatment coefficients (blue line) are statistically indistinguishable from zero, with their 95% confidence intervals consistently overlapping the zero axis up to period $t-1$. This strongly supports the parallel trends assumption.

Furthermore, the plots illustrate a clear, positive structural break in the trend immediately following the reform at $t = 0$. The post-treatment coefficients (red line) exhibit an immediate and persistent positive jump, visually affirming a heightened propensity to select female GMs post-2018. The finding aligns with recent international evidence, which underscores the necessity of institutional and policy interventions to address persistent gender disparities in healthcare leadership. This research highlights the systemic barriers that remain and calls for greater accountability and systems-level changes to ensure equitable representation (Levy et al., 2025; Baduge et al., 2024).

Table B15: ATT estimates of the Reform's Impact on the Appointment of Female General Managers using the Callaway and Sant'Anna model and the Wooldridge method, with the Not-Yet-Treated approach, comparing the pooled sample (Panel a) and the LHAs in regions outside (Panel b) and within (Panel c) the Recovery Plan.

	Callaway and Sant'Anna				**JWDID**			
Outcomes	ATT	S.E.	P-value	PreTrend Test	ATT	S.E.	P-value	PreTrend Test
Panel a: Pooled Sample								
Gender	0.117*	(0.067)	0.080	0.5951	0.130**	(0.059)	0.028	0.6293
Panel b: Recovery Plan = 0								
Gender	0.095	(0.099)	0.339		0.146	(0.094)	0.121	
Panel c: Recovery Plan = 1								
Gender	0.182**	(0.088)	0.039	0.8558	0.123*	(0.073)	0.091	0.3328

On the whole, the figure suggests a gradual yet meaningful movement toward gender parity in managerial positions within the healthcare system, echoing previous research that emphasises the importance of accountability mechanisms and targeted interventions to strengthen women's leadership pathways (Buse et al., 2024; Mousa et al., 2021).

B.4 Descriptive Statistics

Building on the empirical results discussed in the previous section, this section provides additional descriptive evidence to contextualise our findings and illustrate the heterogeneity across Local Health Authorities (LHAs) and over time. We first examine the distribution of the main clinical outcome—30-day mortality following femur fracture—across adoption groups, then analyse the joint behaviour of the economic–financial and clinical performance indicators, and finally characterise the demographic and educational profiles of general managers.

As a first step in exploring this heterogeneity, Figure B5 depicts the kernel density estimates of the 30-day mortality rate following femur fracture, distinguishing between regions subject to a Recovery Plan and those that are not. The visual comparison reveals a distinct distributional shift, corroborating the structural gap highlighted in the descriptive statistics.

The distribution for LHAs in regions not subject to a Recovery Plan (green dotted line) is clearly positioned to the left, indicating generally lower mortality rates, with a sharp mode centered around 5%. Conversely, the curve representing LHAs in regions subject to a Recovery Plan (red dashed line) is shifted to the right, exhibiting a higher mode (approximately 7%) and a greater probability mass concentrated on poorer clinical outcomes. This observation, illustrating a deterioration in health performance for regions under Recovery Plans, confirms and reinforces the findings emerging from our previous analyses.

Building on this contextualization, we now refine the analysis by disaggregating the sample according to the timing of technology adoption.

Figure B6 presents the kernel density distributions of the 30-day mortality rate following femur fracture across the three adoption groups, considering the entire period of analysis. The curves display an overall similar pattern, with a marked concentration of observations between approximately 4% and 10% mortality.

The early adopters (red dashed line) exhibit a slightly more pronounced concentration around the mode, suggesting lower dispersion and more homogeneous performance within the group. The never adopters (blue solid line) show a wider distribution, with a heavier right tail, indicating greater heterogeneity and the presence of facilities with relatively higher mortality rates. The late adopters (green dotted line) lie in an intermediate position, with a density profile similar to that of the early adopters but characterized by greater variability.

Overall, the figure shows that, although it refers to the entire observation period, early adopters tend to display, on average, better performance and lower variability compared to the other groups.

To further characterise the sample before turning to the causal analysis, we now examine the main economic–financial and clinical outcome variables for Local Health Authorities (LHAs). Summary statistics for these variables, both in the pooled sample and by adoption timing, are reported in Table B8 and Table B10. Overall, the indicators reveal substantial heterogeneity across Local Health Authorities (LHAs) in both economic–financial and clinical dimensions. In the pooled sample, the average Operating Margin (EBIT) is 5.453 with a large standard deviation (8.244) and a wide range (from -12.920 to 12.031), mirrored by the dispersion in the Gross Operating Surplus (EBITDA), which averages 10.133 but spans from -12.388 to 13.121. The Revenue-to-Cost Ratio centres just above unity (mean 1.008, SD 0.018), indicating overall financial balance but with a non-negligible share of units temporarily operating below cost recovery. The Financial Viability Index is slightly negative on average (-0.125, SD 0.113), consistent with moderate but diffuse fiscal pressure across LHAs. On the clinical side, the mean 30-day mortality after femoral neck fracture is 6.122, with high variability (SD 2.458) and extreme values exceeding 27, while 30-day hip readmissions average 4.616. The mean of femur surgeries performed within two days is about 60.5 (SD 18.988), reflecting marked differences in the timeliness of care. The rate of hip revision within two years is 2.254, which is also heterogeneous across observations. The descriptive statistics for the conditional variables underscore significant structural differences in organizational capacity and catchment size. The total *Staff*—defined as the aggregate of physicians and nurses—averages 2,187.952 (SD 1,666.112), reflecting substantial heterogeneity in provider size. Decomposing this figure, the physician workforce averages 640.120 while the nursing staff averages 1,547.833. The disparity in scale is striking, with total staff counts ranging from a minimum of 33 to a maximum of 9,567. This heterogeneity extends to catchment characteristics: the average population served is approximately 608,490 residents, yet it ranges from smaller districts of around 127,000 to large metropolitan hubs exceeding 3.4 million. Similarly, the average municipal income displays vast dispersion (mean 3.47×10^9, SD 8.44×10^9), confirming that the sample spans socio-economic contexts of vastly different magnitudes.

Stratifying the descriptive statistics by region subject to Recovery Plans and those in ordinary regions, in Table B9, we can observe that clinically, LHAs in regions under Recovery Plans exhibit markedly poorer outcomes: 30-day mortality is higher (7.049 vs. 5.427) and the timeliness of surgery is significantly lower, with only 54.1% of femur fractures treated within two days, compared to 65.4% in the rest of the country. Financially, a dichotomy emerges. While operating margins (EBIT and EBITDA) appear paradoxically robust in Recovery Plan regions—likely reflecting the stringent cost-containment measures and freezing of expenditures mandated by the administration—their service attractiveness is critically low. The patient mobility index is drastically inferior (9.616) compared to regions not under financial administration (35.302), suggesting a limited capacity to attract patients from other territories. Finally, resource constraints are evident in the workforce composition: LHAs under Recovery Plans rely on a smaller total staff (2,070 vs. 2,275), with the gap being particularly pronounced in the nursing component (approx. 1,399 vs. 1,658), consistent with the turnover blockages often associated with these financial adjustment programs.

When statistics are disaggregated by adoption timing, clear differences emerge. Early adopters exhibit the strongest financial conditions, with the highest EBIT (7.533) and EBITDA (10.923), a higher Revenue-to-Cost Ratio (1.013), and a less negative Financial Viability Index (-0.089). Never adopters show similar but slightly weaker averages (EBIT 7.031; FVI -0.133), while late adopters display notably lower financial margins (EBIT 3.961; EBITDA 9.725; FVI -0.129) and greater dispersion, suggesting tighter fiscal constraints and more unstable economic performance. Health and quality indicators are more homogeneous across groups, although small gradients appear. Femur 30-day mortality hovers around 6 for all groups, while the share of femur surgeries performed within two days is highest among never adopters (63.3) and early adopters (62.0) and lowest among late adopters (58.5), hinting at slower care processes where financial performance is weaker. Hip readmissions (around 4.6) and revision rates within two years (around 2-2.5) are comparable across categories. Taken together, these descriptive patterns suggest that financially constrained LHAs-mainly late adopters-tend to perform slightly worse on process efficiency indicators, whereas clinical outcomes show no clear systematic divergence across adoption groups.

The presence of wide within-group dispersion underscores the importance of relying on panel estimators and event-study approaches to isolate policy effects beyond compositional heterogeneity.

Subsequently, we analyse the distribution of age across years and genders. The graphical evidence in Figure B9 illustrates the distribution of age for the individuals in the sample for each year from 2015 to 2021, separately by gender. Across all years, the shape of the distribution remains very similar, indicating that the age structure of the sample is relatively stable over time. Most observations lie in the 50–70 age range, with a peak around 55–60 years, suggesting that the sample is predominantly composed of individuals in the higher age classes, while younger and very old individuals are comparatively less represented. The absence of visible shifts in the location or dispersion of the distributions across years indicates that there are no major compositional changes in terms of age, so temporal variations in the outcome variables are unlikely to be mechanically driven by changes in the age profile of the sample.

The figure also documents that the age distributions for men and women are broadly comparable. In each year, the two curves almost overlap, pointing to very similar age structures by gender. There is, however, a slightly higher number of male observations in several age classes and, in some years, a somewhat more pronounced concentration of men at the upper end of the age distribution. These differences remain limited and do not suggest strong gender-specific trends over time. Overall, the evidence indicates that the joint distribution of age and gender is highly stable over the period considered, reducing concerns that shifts in the main variables of interest might be confounded by changes in the demographic composition of the sample.

To complement the descriptive statistics, we analyse the educational background of the general managers. Table B12 summarises the distribution of university degrees held by the general managers of local health authorities (LHAs) by gender and year. Degrees in health-related fields include Medicine and Health Courses, the latter comprising Nursing and Midwifery, Biology, Hygiene, Nursing Sciences, Psychology, and Pharmacy. Degrees in other fields include Law, Engineering, Economics, and Others, where the residual category “Others” covers Computer Science, Sociology, Political Science, Philosophy, Physics, Agricultural Sciences, Mathematical Sciences, and Humanities. For each field of study, the rows display annual shares and, in the last three columns, the average percentages for 2015–2017, 2018–2021, and the full 2015–2021 period.

For women, the upper panel shows that health-related education is important but not predominant. The share of female general managers with a degree in Medicine fluctuates between roughly 31% and 54% across years, while other Health Courses remain consistently marginal. When aggregating by period, the proportion of health-related degrees (Medicine plus Health Courses) declines from 46.0% in 2015–2017 to 42.1% in 2018–2021, yielding an overall share of 43.7% over the whole period. Consequently, more than half of female general managers hold degrees in non-health fields, with Law and Economics accounting for an increasing fraction in the post-2018 period, as indicated by the corresponding columns.

For men, the lower panel documents a much stronger predominance of health-related training. In almost every year, more than 55% of male general managers hold a degree in Medicine, with peaks above 60% in several years between 2017 and 2019. The period aggregates confirm that the share of health-related degrees remains high and broadly stable over time: 60.7% in 2015–2017, 58.4% in 2018–2021, and 59.4% over the full sample. Non-health fields are therefore less common among men, although the table points to a gradual increase in the presence of Engineering degrees in the more recent period. Overall, the evidence indicates that the top management of LHAs is characterised by a strong presence of general managers with health-related degrees—especially among men—while women are relatively more likely to access these positions with legal, economics, or other non-health backgrounds, suggesting a mild trend toward greater diversification of educational profiles over time.

Conclusion

This thesis has examined the sustainability and effectiveness of the Italian National Health Service (NHS) through three complementary perspectives: the availability and use of external financial resources, the interaction between macroeconomic fluctuations and the health status of the population, and the role of governance quality and managerial selection within local health systems. Taken together, the three essays offer a multi-level perspective on how financial, economic and organisational factors jointly shape the capacity of a universalistic health system to guarantee equitable and high-quality care in the presence of persistent fiscal pressures, population ageing and territorial inequalities.

The first chapter has shown how the European Structural and Investment Funds (ESIF) have, in fact, become an additional pillar of health financing in Italy, despite not being primarily conceived as instruments for the health sector. Through a systematic mapping of "health-related" projects in the 2014–2020 programming period, it constructs a new regional database that documents over 6.19 billion euros invested through ERDF and ESF in 26,739 projects. This descriptive effort fills a significant gap in the literature, given the absence of official national compilations of structural fund allocations specifically devoted to health infrastructure, technology, training and public health policies. The analysis shows that these resources are distributed very unevenly across regions and beneficiaries: Southern regions such as Puglia and Campania emerge as the main recipients, particularly for infrastructure and technological investments, while the ESF is more strongly oriented towards training and social inclusion, with a prominent role in supporting the care of non-self-sufficient individuals and in providing income support to vulnerable house-holds.

These findings are directly connected to the broader debate on Cohesion Policy, regional development and “absorption capacity”(Ederveen et al., 2006,Becker et al., 2012). The Italian case illustrates how EU funds can function as a powerful tool for upgrading the infrastructure and capabilities of the health system, but their impact is mediated by regional administrative capacity, strategic priorities and governance quality. Structural funds are not neutral injections of capital: they interact with pre-existing territorial fractures and can either mitigate or, in some cases, inadvertently reinforce inequalities in access to care, depending on how projects are selected, designed and implemented. In a context where the NHS is founded, at least formally, on the principles of universality and equity, the use of additional, project-based co-financed resources represents both an opportunity and a risk: an opportunity to channel further investment to lagging areas, and a risk that regions less able to conceive and manage complex projects will fall even further behind.

The second chapter has shifted attention from financial resources to the macroeconomic environment in which the NHS operates, analysing the relationship between business cycles and mortality in Italy using provincial data from 2004 to 2019 and then extending the analysis to the years 2020–2021 to include the COVID-19 shock. Building on a rich international literature on the procyclicality of mortality (Ruhm, 2000,Gerdtham & Ruhm, 2006, Neumayer, 2004), the chapter applies panel models with fixed effects to national mortality statistics disaggregated by cause of death, age, gender and educational attainment. The results document a predominantly procyclical pattern: an increase in unemployment is associated with a reduction in mortality, particularly among men, young people (16–24 years) and individuals with higher levels of education, and for specific causes such as road accidents, suicides and cardiovascular diseases.

These findings challenge a simplistic narrative according to which recessions are uniformly harmful to health, and highlight the importance of behavioural, environmental and labour market channels that may improve certain health outcomes during crises (for example, reductions in traffic, work-related stress or risky behaviours), while at the same time worsening others. The extension to the pandemic years shows that COVID-19 constitutes a structural break with respect to these historical regularities: the previously negative relationship between unemployment and mortality weakens and becomes statistically insignificant, while deaths from respiratory diseases take on a countercyclical pattern. This reinforces the idea that the link between macroeconomy and health is contingent on the institutional context, the configuration of the welfare state and the nature of shocks (Stuckler et al., 2009), and that health policies must be explicitly counter-cyclical and adaptive, rather than assuming a stable relationship between economic conditions and population health.

The third chapter has brought the analysis inside the "black box" of the NHS, investigating whether reforms in the mechanisms for selecting top managers can improve the performance of Local Health Authorities (LHAs). Exploiting Legislative Decree 171/2016 as a source of quasi-experimental variation, it constructs a new LHA-level panel for the period 2015–2021 that combines administrative indicators from the Ministry of Health and AGENAS, socio-economic data from ISTAT and an original longitudinal roster of General Managers and their curricula. This unique dataset makes it possible to track managerial turnover and to characterise the educational background, gender and professional profile of the managers appointed before and after the reform.

From a methodological point of view, the chapter employs a Difference-in-Differences framework with staggered treatment, combining traditional two-way fixed effects models with staggered-robust estimators in the spirit of Callaway and Sant'Anna (2021), and using Wooldridge's JWDID approach for binary outcomes. The results show that the reform substantially changed the composition of top management, particularly in regions subject to Recovery Plans, where the share of General Managers with non-health degrees increased and a modest rise in female representation was observed. However, these changes in managerial composition do not translate into systematic improvements in economic–financial performance and are associated with a small but robust increase in 30-day mortality after femoral neck fracture. The analysis of educational background suggests an asymmetric pattern: managers with clinical training appear more frequently at the head of fragile organisations and do not systematically achieve better short-term acute outcomes, especially in financially constrained contexts.

Taken as a whole, the three essays converge on a central message: maintaining the sustainability of a universalistic health system such as the NHS requires more than simply additional resources, more than favourable macroeconomic conditions and more than formal governance reforms. What matters is the interaction between these dimensions and the institutional and territorial context in which they are embedded. Structural funds can channel billions of euros into the health sector, but their effectiveness depends on regional administrative and strategic capacity. Periods of economic expansion can increase incomes and tax bases, but they can also generate health risks through environmental and behavioural channels that require targeted public health responses. Governance reforms can professionalise the selection of managers, but in the absence of adequate autonomy, sufficient staffing levels and coherent accountability frameworks, new appointments may fail to produce the expected improvements.

This multidimensional perspective is consistent with a growing literature that emphasises how health systems are complex adaptive systems rather than simple production functions (Baker, 2001). From the vantage point of the Italian NHS, the thesis suggests that three conditions are particularly important for reconciling universalism, quality and fiscal sustainability.
First, *strategic investment*: European and national resources must be coordinated within a medium- to long-term vision that prioritises reducing territorial inequalities in infrastructure, technologies and human capital, rather than merely maximising absorption capacity.
Second, *adaptive policies*: periods of economic boom and recession affect different population groups and causes of death in heterogeneous ways; health and social policies must anticipate these effects, protecting vulnerable groups during recessions and addressing the risks associated with accidents and work-related stress during expansions.

Third, *managerial professionalisation*: improving selection procedures is necessary, but it must be accompanied by investments in leadership development, stable governance arrangements and sufficient organisational slack so that managers can pursue quality as well as cost containment.

The thesis also has implications for how we conceive equity and cohesion within a decentralised health system. The evidence on structural funds and managerial reform suggests that decentralisation without robust mechanisms of solidarity and coordination risks crystallising pre-existing divides: regions with greater administrative capacity and stronger fiscal bases are better placed both to attract European resources and to exploit reforms, whereas those under tighter central control operate under more rigid constraints and are pushed towards profiles more strongly focused on financial control than on clinical competence. This is particularly worrying in light of longstanding North–South inequalities and of the constitutional commitment to guaranteeing equitable access to essential levels of care. This picture recalls the broader literature on the social determinants of health, which shows how health inequalities reflect and reinforce more general patterns of social and territorial disadvantage (Marmot, 2005).

At the same time, the results highlight numerous possible avenues for future research. On the financial side, richer project-level data could be used to link specific types of ESIF investment (for example telemedicine, primary care infrastructure and training programmes) to changes in service utilisation patterns and health outcomes, helping to identify which forms of investment are most effective in reducing inequalities. On the macroeconomic side, access to more granular or micro-level mortality data would allow finer analysis of the underlying mechanisms, including interactions with air pollution, daily mobility and the sectoral structure of employment. On the governance side, integrating information on middle management, clinical leadership and organisational practices – for example through management surveys (Bloom et al., 2015; Bloom et al., 2020) – would make it possible to better disentangle the contribution of individual managers from that of broader institutional and cultural factors.

More generally, the thesis contributes to an ongoing reflection on what it means to preserve a universalistic health system in the twenty-first century. Italy, like other European countries, faces simultaneous pressures resulting from population ageing – described as a "perfect storm" (Ricciardi, 2015) – the increasing burden of chronic diseases, technological innovation, health risks associated with climate change and the long tail of the COVID-19 pandemic. In this context, the NHS remains one of the most powerful instruments for protecting what Sen (2002) describes as a central dimension of human capability: the ability to lead a healthy life. However, the empirical evidence presented here calls for caution in relying exclusively on injections of resources, macroeconomic growth or formal governance reforms. In the absence of attention to institutional capacity, territorial cohesion and the everyday realities of organisational life in hospitals and health authorities, these levers risk failing to deliver on their promises.

In conclusion, this thesis argues that defending the universalistic nature of the NHS requires a shift from a narrow vision centred on cost containment or isolated reforms to a genuinely systemic perspective. A perspective that recognises how investments, economic conditions and managerial choices are deeply intertwined; that equity must be pursued not only in access to services but also in the distribution of resources and opportunities across territories; and that leadership in healthcare is not merely a matter of individual competence, but depends on the creation of institutional contexts in which competent leaders can effectively act and, through simple rules, on cooperation between organisational levels (Baker, 2001). By documenting how financial, macroeconomic and organisational factors interact in the Italian case, the thesis aims to provide both empirical evidence and conceptual tools to guide the actions of policymakers, practitioners and scholars committed to building health systems that are not only fiscally sustainable, but also resilient, equitable and worthy of the constitutional promise of health as a right for all.

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