Do Incentives and Organizational Innovations Affect the Performance of Public Administration? Lessons from the Italian NRRP

Antonio Accetturo[a], Audinga Baltrunaite[a,b], Elena Lazzaro[a], and Anna Laura Mancini[a]

[a]Bank of Italy
[b]CEPR

March 2026

Please do not circulate or cite without permission.

Abstract

We study how incentives and organizational innovations affect the performance of public administrations in the provision of infrastructure, a core public good. We focus on Italy's National Recovery and Resilience Plan (NRRP), which combines an unprecedented investment program with a distinctive governance model for the delivery of projects. NRRP projects were subject to: (i) performance-based conditionality tied to the achievement of pre-defined objectives; (ii) contracting authorities' qualification and higher procedural discretion; and (iii) higher advance payments for private contractors to accelerate the start of the project. Exploiting variation within and across municipalities we identify the effects of each channel. We find that the NRRP significantly improved the success of procurement awarding. In particular, the performance-oriented approach played a central role in improving administrative performance and was further enhanced by the qualification of procuring authorities. In the execution phase, the higher initial liquidity contributed to the rapid start of construction works, without appreciable effects on the subsequent progress.

Keywords: public administration, structured managerial practices, public procurement, administrative capacity building

JEL codes: D73, H57, H83

1 Introduction[1]

The efficiency of public administration is a central determinant of state capacity and economic performance (Besley and Persson, 2009, 2013). Through its role in planning, procurement, and implementation, the public sector shapes how public resources are translated into infrastructure, services, and welfare-enhancing investments. Yet, public administrations are often characterized by low productivity, persistent delays, and significant implementation gaps, even in advanced economies. Improving the effectiveness of the public sector, therefore, remains a key challenge for both policymakers and scholars.

Despite a growing recognition of the importance of administrative capacity, there is still limited empirical evidence on which policy tools are most effective in enhancing public sector performance. Much of the existing literature focuses on measuring the impact of the levers on the selection stage (e.g. recruiting practices, Moreira and Pérez, 2024; financial incentives, Dal Bó et al., 2013; Deserranno, 2019, etc.), while less is known about the impact of interventions explicitly designed to *modify* incentives and organizational practices within public administrations.[2]

This paper studies the role of incentives and organizational innovations in affecting public administration's performance in public procurement. We focus on the Italian National Recovery and Resilience Plan (NRRP), the country's implementation of the European Recovery and Resilience Facility, which combines an unprecedented investment effort with a distinctive governance model for delivery. Importantly, the NRRP did not merely inject additional funds into public investment. It imposed a specific *implementation method* on public administrations, characterized by a combination of managerial and financial innovations aimed at improving project delivery. First, funding is conditional on the achievement of pre-defined milestones and targets, creating strong performance incentives and a structured monitoring framework for public administrations. Second, the Plan introduces organizational changes in procurement, including the qualification of contracting authorities and the obligation for lower-capacity municipalities to delegate procurement tasks to specialized centralized agencies. Third, it modifies the financial structure of contracts by granting higher advance payments to private contractors that can ease liquidity constraints and therefore facilitate the first execution phases. Together, these features define a distinctive implementation model

[1]We are thankful to Federico Cingano, Sauro Mocetti, Andrea Petrella and participants at numerous internal and institutional seminars. All remaining errors are our own. The opinions expressed in this paper do not necessarily reflect those of the Bank of Italy.

[2]Dwenger and Gumpert (2025) is one notable exception that provides the first causal estimates of the effects of seconding officials from high-capacity to lower-capacity administrations on both output quantity and quality in German public administration.

that affects both the incentives and the organizational environment in which public administrations operate. This bundle of practices (discussed in more detail in Section 3) provides an opportunity to evaluate whether and how "managerial technologies" imposed by the NRRP translate into measurable improvements in public sector performance.

We take public procurement as a natural and policy-relevant laboratory. Procurement is a key bottleneck for public investment: it governs the transition from planning to contract awarding and, ultimately, to execution. At the same time, procurement generates high-frequency administrative traces that allow outcomes to be measured along the project life-cycle. In particular, we use granular data from the National Anti-Corruption Authority (ANAC) on public works' tenders published in the period 2016-2023 combined with the data from *Casse edili* on construction progress status. The resulting dataset allows us to study both award-stage performance (the likelihood and speed of awarding) and implementation-stage outcomes (indicators for project start, progress, and completion). The distinction between the two procurement phases is operational for the isolation of different channels, because it plausibly affects different stages through different components: procedural simplification should primarily relax frictions in awarding, whereas funding certainty, oversight, and structured project management are expected to be especially, but not exclusively, salient for execution.

A core empirical challenge is that NRRP-funded contracts differ systematically from other procurement contracts, and NRRP participation is nearly ubiquitous across municipalities, making it difficult to construct clean untreated control groups. We address these challenges with a two-step empirical design that separates contract-level effects from municipality-level organizational responses. First, we compare NRRP and non-NRRP contracts *within the same municipality and publication year*, using saturated municipality-by-year fixed effects to absorb all local time-varying conditions and propensity-score reweighting to align NRRP and non-NRRP contracts on key observable characteristics (such as value, sector, and procurement modality). This first step isolates how contracts managed under the NRRP perform relative to comparable non-NRRP contracts issued by the same administration in the same year.

Second, we study whether the application of the NRRP rules is associated with broader changes in procurement performance beyond directly treated contracts. We recover a municipality-year performance of non-NRRP projects component from the first-step regressions and relate its evolution to predetermined measures of NRRP exposure, implementing a continuous-treatment difference-in-differences design. This step speaks to whether the NRRP introduced organizational routines that are portable within the administration—through learning-by-doing, reorganization, or redeployment of administrative in-

puts— can affect the performance of other, non-NRRP procurement activity.

The NRRP appears to have generated positive effects in the awarding of public procurement contracts. Contracts tied to NRRP exhibit substantially better tender-stage outcomes: they are more likely to be awarded and are awarded faster. Most important, our detailed data and the institutional knowledge allow to disentangle different channels through which the Plan affects the awarding phase. While procedural discretion seems to have generated limited effects, the overall improvement in procurement outcomes is mostly driven by the performance-oriented approach to public tendering that establishes clear conditionality of funding on the achievement of the projects. Moreover, we show evidence that procurement activity centralization in the hands of the more qualified agencies amplifies the effects. These insights are highly relevant for policy making, in particular, regarding the introduction of a credible threat of funding withdrawal.

Innovations that concern the implementation stage are, instead, concentrated on projects that remain fully under the NRRP framework (as opposed to the projects defunded by the first Plan's revision in late 2023). They are mostly linked to the pressure of local agencies to facilitate the swift project progress and to higher initial liquidity for private firms that implement the project. Interestingly, while we find evidence of the positive effect of the NRRP on the opening of the worksite, the size of the effects decreases with the expected project progress possibly also reflecting the shift in reporting and accounting procedures introduced by the NRRP compared to previous frameworks, which may require an adaptation period for firms and municipalities and entail procedural adjustments capable of temporarily slowing down subsequent implementation stages. This pattern suggests an important role played by more generous advance payments that relax liquidity constraints hauling the opening of the worksites. They, however, act mostly by front-loading execution activity without overall improvement in the execution speed. The lack of strong effects along the entire project life-cycle also warns that the pre-existing structural challenges in the economic system are difficult to overcome by acting on the administrative activity alone and may require imposing stronger performance incentives also for private actors.

In addition, we find no evidence of negative spillovers on other contracts. If anything, municipalities more exposed to the NRRP display improved performance in the awarding phase of non-NRRP procurement. This pattern is consistent with the presence of organizational learning or capacity spillovers within public administrations induced by the NRRP implementation method, rather than with congestion or crowding-out effects.

The paper is organized as follows. Section 2 presents a review of the most relevant literature

and highlights the contribution of the paper. Section 3 describes the institutional setting. Section 4 and 5 present, respectively, the data and the empirical strategy. Section 6 shows the result of the direct effects of NRRP on the Italian procurement system. Section 7 analyzes the spillover effects of NRRP on other non-NRRP projects. Section 8 presents a set of robustness checks. Section 9 concludes.

2 Literature Review and Contribution

Our study is situated at the intersection of three broad fields of research: organizational economics applied to the public sector, the analysis of public procurement, and the evaluation of large-scale investment programs. Our primary contribution is to provide an analysis of the NRRP's effects on a comprehensive set of procurement performance outcomes and to single out how different components of the program relate to project performance.

The classical view of bureaucracy describes it as a rational, rules-based machine (Weber, 1978). Modern organizational economics, however, analyzes public entities as complex organizations whose outcomes depend on incentives, monitoring, and managerial practices (Wilson, 2019; Dixit, 2002). Seminal research has shown that the adoption of structured management practices is strongly correlated with higher productivity in the private sector (Bloom and Van Reenen, 2007). Due to the high costs of measuring organization practices and obtaining performance measures on a broad scale, the evidence on the public sector is relatively scant. The existing contributions, nevertheless, recognize the relevance of management quality also for public sector performance, in particular, in education (e.g., Leaver et al., 2024, Lemos et al., 2024) or healthcare sectors (e.g., Bloom et al., 2020, 2015).

Beyond organizational practices, a growing body of evidence shows that leadership capacity is a key determinant of the quality and efficiency of public services and investment. In particular, studies in the Italian context have linked performance with the quality of politicians (Gagliarducci and Nannicini, 2013) or of administrations (Baltrunaite et al., 2025).

Much of existing research focuses on measuring the existing capacity, shaped by policies in the selection stage, rather than on evaluating interventions designed to enhance it. The NRRP, instead, constitutes a large-scale intervention that explicitly imposes the adoption of a *project management* model – i.e., conditionality of funding on performance, definition of intermediate objectives, systematic reporting and monitoring. Our study, therefore, contributes to the literature on the organization of the public sector by measuring the link between exposure to this new organizational model and the procurement performance. Moreover, by measuring the performance of non-NRRP procurement contracts we are able to explicitly investigate

the potential for organizational spillovers: that is, whether the new management practices introduced by the NRRP can function beyond their direct application and catalyze a general improvement in local administrative capacity.

The literature on public procurement analyzes the fundamental trade-off between efficiency (e.g., time, cost) and other objectives such as quality, transparency, and corruption prevention (Spagnolo, 2012). Italy, in particular, has been the subject of numerous studies highlighting significant inefficiencies in its procurement system. This research has documented how outcomes are shaped not only by bureaucratic delays but also by institutional design choices, such as the degree of purchasing centralization (Coviello et al., 2018), and by the persistent challenge of finding an optimal balance between rigid, anti-corruption rules and the administrative discretion needed for efficiency (Decarolis et al., 2025).

A useful framework for categorizing these inefficiencies is the distinction introduced by Bandiera et al. (2009) between "active waste" and "passive waste". Active waste stems from corruption and the deliberate pursuit of private gain by public officials. Passive waste, in contrast, arises from bureaucratic inefficiency, lack of managerial effort, or limited administrative capacity, resulting in suboptimal outcomes even in the absence of illegal behavior. While both are critical issues, our study's primary focus is on the determinants of passive waste. We investigate whether an intervention designed to enhance organizational capabilities and streamline procedures can reduce the bureaucratic delays and execution failures that characterize this form of inefficiency.

Moreover, our paper contributes to the literature that focuses on the impact evaluation of large-scale investment programs, overall, and, particularly so, on the effects of the NextGenerationEU program. This topic has received a great deal of attention from national and European institutions that provide a number of descriptive analysis (among others Corte dei Conti, 2025; Fantozzi and Gabriele, 2025; Camera dei deputati, 2025). Furthermore, several empirical papers focus on the program's impact on the macro-economic growth of the European economies (Bańkowski et al., 2024) and on European regions (Ángel Almazán-Gómez et al., 2025), the realization of welfare reforms addressing key social vulnerabilities (Corti and Vesan, 2023), the speed of the firms' engagement in the Twin Transition (Ferri et al., 2023) or, in the Italian context, the potential of the South-North convergence (Mauro and Pigliaru, 2024) and the effect on regional employment (Camussi et al., 2024). Closest to ours Bucci et al. (2026) analyze projects co-financed with the NRRP funds by *Cassa Depositi e Prestiti* and show that the performance-based financing reduces administrative implementation delays of public investments. Gori et al. (2024) instead examines the impact of the new Public Contracts Code and of the revision to Italian NPRR proposed in July 2023 on municipal procurement

procedures for public works, finding that the uncertainty prior to the NPRR reformulation induced an average 14% reduction in the speed of involved project implementation, with particularly pronounced effects in small municipalities.

This paper makes three main contributions to the existing literature. First, we offer a a disaggregated analysis of a reform package: unlike studies that estimate a single "net" effect of the large-scale investment projects in general (or NRRP, in particular), our empirical framework is designed to disentangle the relationships between project performance and the plan's main levers: performance-based conditionality tied to the achievement of objectives and procurement agencies qualification (due to centralization , this last characteristic found to be an accelerating factor by Gori et al. (2022)) couple with higher procedural discretion on the administration's side and anticipated liquidity injection to kick-start the projects on the private contractor's side. While we acknowledge the limitations of the empirical design for causal inference, we argue that this disaggregation provides a more granular picture of which components of the plan are most closely associated with project success.

Second, by tracking investments from the initial tendering to final realization stages, we are able to offer a comprehensive picture on how NRRP affects the projects' life-cycle and sheds light on the role of different actors in this process. In particular, we document robust evidence that organizational innovations targeting public adminsitrations were effective in enhancing their administrative performance, in particular, that pertaining to successful tender awarding. The results on the execution phase - where progress is highly dependent on the private contractor effectively executing the project, and where municipal administrations only exert monitoring and mostly contribute by alleviating administrative frictions - are more nuanced, suggesting that the successful project implementation does not only depend on public sector performance, but also on the incentives' structure in which private sector actors operate.

Third, we show evidence of spillover effects of NRRP-mandated management practices onto a municipality's standard, non-NRRP projects. This sheds the first light on one of the core questions in organizational economics, i.e., whether top-down interventions can trigger lasting organizational and cultural changes within the public administration, thereby improving overall efficiency beyond the specifically funded projects. To date, empirical evidence on such spillovers at the local government level is extremely limited, and we highlight the importance of addressing it in future research.

3 Institutional Setting: The Italian NPRR

The National Recovery and Resilience Plan (NRRP, or *Piano Nazionale di Ripresa e Resilienza*) is the program submitted by Italy to access the resources of the "Recovery and Resilience Facility" (RRF). The RRF is the core instrument of the *NextGenerationEU* (NGEU) program, the temporary recovery instrument established by the European Union in 2020 to repair the immediate economic and social damage brought about by the COVID-19 pandemic and, simultaneously, to accelerate the green and digital transitions. Italy was allocated €194.4 billion (in grants and loans), supplemented by additional national funds, making the NPRR an unprecedented public finance intervention in terms of both size and ambition. The Plan is structured in 6 Missions that represent the thematic and strategic areas of intervention, such digitalization, innovation, competitiveness, green transition, infrastructure, eduction or health. Further details on the Plan's composition are provided in the Appendix A.

Three aspects of the institutional design of the NRRP are fundamental to this study. First, unlike traditional EU structural funds disbursed based on the reported costs, the NRRP is a performance-based program, whose financing is strictly conditional on the achievement of pre-defined and measurable milestones and targets[3] (further - M&T), as established by the EU regulation that created the Recovery and Resilience Facility (European Union, 2021).

The original Italian NRRP, as approved by the EU, included 527 M&T to be achieved by mid-2026 (European Council, 2021). Funds are disbursed in semi-annual tranches, following a formal payment request by Italy reporting the achievement of the relevant M&Ts and a positive assessment by the European Commission (and subsequent approval by the ECOFIN Council) certifying the effective achievement of the M&T for that period.

Second, this conditionality mechanism imposes a dual level of monitoring. At the European level, the Commission exercises ex-post control over the achievement of results before authorizing payments. At the national level, a centralized governance structure was established at the Ministry of Economy and Finance (MEF - Central Service for the NRRP) to coordinate and monitoring progress (Governo Italiano, 2021). To this end, all "implementing bodies" (*soggetti attuatori*) — such as Ministries, Regions, and particularly the Municipalities — are required to continuously enter and update data on the procedural, physical, and financial progress of their projects on the single IT platform *ReGiS* (Ministero dell'Economia e delle Finanze - Ragioneria Generale dello Stato, 2022). The presence of external and internal

[3]Milestones are qualitative achievements that measure crucial intermediate phases of a reform or investment (e.g., the entry into force of a law, the publication of a call for tenders, the completion of a procurement procedure). Targets are quantitative results that measure the final output of an intervention (e.g., the number of kilometers of railway built, the number of buildings requalified, the number of new childcare facilities).

monitoring, effectively imposes a "structured project management" model, representing a significant novelty for many Italian public administrations and reforming the way public projects are managed by Italian public administrations.

Third, to accelerate project delivery, Italian procurement regulation evolved along two parallel tracks: a set of special rules targeted at the NRRP and a broader, structural reform of the entire system. In particular, a special legal framework for the NRRP was introduced by Decree-Law 77/2021 (Governo Italiano, 2021). This decree established a set of specific regulations applicable only to projects funded by the NRRP and the Complementary National Plan (*Piano Nazionale Complementare*, PNC). These rules, in derogation from the contemporary Public Procurement Code (Legislative Decree 50/2016), aimed to streamline procedures and increase the administrative capacity of procuring agencies.[4]

The NRRP-targeted deregulation consisted of several arms:

- acceleration tools, such as the shortening of the time limits for the "public debate" and the suspension of the obligation to obtain the opinion of the High Council of Public Works for Public Investments (*Consiglio superiore dei Lavori Pubblici per gli Investimenti Statali*) in project planning, the possibility to resort to the negotiated procedure without prior publication for reasons of extreme urgency;
- derogatory rules in environmental and landscape matters concerning the authorization procedures for projects included in the NRRP;
- centralization of the public procurement function whereby all municipalities, except for provincial-capitals (*capoluoghi*) shall resort to the central purchasing bodies or to qualified aggregators (i.e., procuring authorities entitled to tender for projects above certain size categories) for the NRRP projects; all municipalities can manage procurement related to non-NRRP projects on their own behalf;
- technical assistance to procuring agencies, whereby Consip S.p.A.[5] shall share their *good-practice* by providing contract templates, *ad hoc* technical support and by implementing

[4]In parallel, Italy undertook a general reform of its public procurement system implemented by a new Public Procurement Code (Legislative Decree 36/2023), effective from July 1, 2023. It significantly simplified the procurement system for all procurement contracts, via the expansion of the use of discretionary procedures in procurement contracts awarding, and raised the qualification requirements for contracting authorities, aiming to achieve the acceleration of the administrative process without compromising the quality of public procurement purchases (Governo Italiano, 2023). In addition, the new code ensured that the special derogation for NRRP projects remains in force to guarantee their timely completion.

[5]Consip S.p.A. is an Italian joint-stock company entirely owned by the Ministry of Economy and Finance, acting as the central purchasing body for the Italian Public Administration. It promotes efficiency and transparency in public spending by managing digital procurement platforms (e-procurement) and framework agreements for goods and services, as well as providing consultation for the procurement of public goods and services.

training programs in the management of procurement procedures;

- personnel recruitment to support the realization of the NRRP projects; even if it is not possible to determine whether these staff worked directly on NRRP-related activities or were allocated to other tasks, indirectly freeing up internal resources also for the Plan, the recruitment represented nevertheless an overall reinforcement of administrative capacity.
- the establishment of the Fund for Non-Deferrable Works (*Fondo per le Opere Indifferibili*, FOI) in 2022, with the aim of supporting contracting authorities for projects financed with NRRP resources (or those of the National Complementary Plan) by adjusting the reserve prices to rising construction costs and by widening the pool of firms potentially interested in participating;
- the 30% advance payment for NRRP projects (an increase from the statutory 10%), aimed at accelerating the start of the execution phase of public works. This measure was introduced in 2024 and presumably benefited more projects that were awarded in 2023 than those awarded before.[6]

The Plan's composition was not static: in mid-2023, the Italian government proposed a comprehensive revision of the NRRP, formally approved by the EU Council in December 2023. The revision was deemed necessary to address rising inflation, implementation delays and to integrate the new REPowerEU chapter. It involved the defunding of approximately €15.9 billion projects originally in the NRRP, primarily affecting measures managed by municipalities, such as urban regeneration, the construction of nursery schools and hydrogeological risk interventions (European Council, 2023).

Since more than half of the defunded resources were linked to projects for which procurement procedures had already been initiated or concluded, and about one fifth referred to projects at an advanced stage of implementation, for which municipalities had already incurred expenditures, their funding was reprogrammed to alternative sources, primarily the national Development and Cohesion Fund 2021-2027 (*Fondo per lo Sviluppo e la Coesione*, FSC) and other existing structural funds. We exploit this change in the NRRP-status of projects wherein they lost their NRRP funding and the resulting performance-based approach and monitoring framework — as the source of variation in our identification strategy. In other words, while the defunded NRRP projects benefited from the swifter administrative action due to

[6]Other NRRP-specific rules consisted of the liberalization of the use of the *integrated procurement* allowing to award the final design, the executive design, and the execution of works through a single tender, the shortening of the litigation times or the possibility to appoint commissioners in cases where the public administration in charge fails to proceed. However, in the paper we abstract from the analysis of these features because they involved a rather narrow and specific set of contracts.

performance-oriented project management and other measures targeting NRRP measures, their execution stage was no longer subject to intense monitoring aimed at completion of the NRRP objectives.

4 Data and descriptive statistics

For the analysis in the paper, we combine multiple data sources. First, we use open data provided by the National Anti-Corruption Authority (ANAC) for the universe of public works tenders published in the period 2016-2023. It contains detailed information on the contract base price, type of works, contracting authority, procurement procedure type and its duration, winning contractor's identity and the awarding price. The unit of observation is the single tender ("project").

Although in theory ANAC's data contain also information on public works' execution status, the data coverage, however, is incomplete, possibly due to partial compliance with the reporting obligations from the contracting authorities. We, therefore, use data provided by the Association of Private Construction Contractors (ANCE) on construction sites that include information on the execution phase of public works, such as progress updates, for the period 2021-2023. Due to the mandatory reporting of the workforce active on the worksite for insurance purposes, the quality of these data is significantly higher and allows to construct comprehensive high-coverage measures of the projects' progress. The detailed definitions of the main variables are presented in the Appendix Table B.1.

We further restrict our focus on municipalities, which are key "implementing bodies" (*soggetti attuatori*) for many investments. This choice also guarantees a uniform geographic coverage across the Italian territory and allows to enrich the data with the granular measures of administrative quality for each contracting authority. In particular, we proxy municipal administrative capacity using the Municipal Administrative Quality Index (MAQI) (Cerqua et al., 2025), a composite index based on 11 indicators that captures: i) bureaucratic efficiency and capacity (e.g., average years of education; personnel turnover), ii) characteristics of local political leadership (e.g., education level; professionalism of administrators) and iii) financial management and investment capacity (e.g., revenue collection capacity; expenditure rigidity). We then explore the heterogeneity of the results between low high capacity municipalities using the pre-NRRP index corresponding to years 2018-2019 and also separately along each component.

After the basic cleaning and the removal of outliers above the 99% of the tender base price and the NRRP exposition, we obtain the final sample of 204,946 observations, of which 178,506

are non NRRP contracts and remaining are 6,275 regular NRRP and 20,158 NRRP defunded contracts.[7]

Table 4.1 shows the descriptive statistics of the main variables of interest, separately for non-NRRP and NRRP contracts, with the distinction between regular and defunded ones for the latter group. In terms of size, public works' contracts tendered by the Italian municipalities in our sample period are medium-sized: an average tender outside the Plan amounts to around 200 thousand euros, while among the NRRP contracts, the active ones are significantly larger amounting to over 700 thousand euros. The vast majority of them correspond to standard procurement of construction works that are mostly awarded using negotiated procedures and direct awards. In terms of works categories, almost two thirds of the non-NRRP sample correspond to construction of residential or industrial buildings and roads; the proportion of the buildings' category is more prevalent among the regular NRRP projects where they account for almost 60% alone.

5 Empirical strategy

Our empirical strategy is designed to separately identify channels through which the NRRP may affect public procurement outcomes. We implement a two-step procedure. The first step exploits within–municipality-year variation at the contract level to estimate the *direct* effect of NRRP status on contract outcomes, while flexibly controlling for time-varying municipality-level conditions. The second step relates the estimated municipality-year components, that is estimated on the non-NRRP projects, to pre-determined measures of NRRP exposure, thereby recovering the *spillover* effect on overall administrative performance.

First step: contract-level effects with saturated municipality-year fixed effects. In the first step, we estimate the following contract-level model:

$$Y_{cit} = \alpha_{it} + \gamma\,\mathrm{NRRP}^{+}_{ct} + \delta\,\mathrm{NRRP}^{-}_{ct} + \boldsymbol{\eta}'\mathbf{X}_{ct} + f(T_{ct}) + \varepsilon_{cit}, \tag{1}$$

where c indexes contracts, i municipalities, and t publication years. The dependent variable Y_{cit} denotes one of our procurement outcomes, measured either at the awarding phase

[7] NRRP contract information is sourced from *Italia Domani* (https://italiadomani.gov.it), the official Italian government platform for monitoring the National Recovery and Resilience Plan implementation. We identify NRRP contracts through CUP codes (*Codice unico di progetto* - Unique project identifier) linked to NRRP projects. Contracts are classified as "defunded" if they were initially included in the NRRP but subsequently removed following the Plan revision implemented in December 2023. Active NRRP contracts are those that remained in the revised Plan and continued to receive EU funding and monitoring.

Table 4.1: Descriptive Statistics by Treatment Group

Variable	Non-NRRP (N=178,513)	NRRP Regular (N=6,275)	NRRP Defunded (N=20,158)
Contract characteristics			
Contract value (€)	212,558	715,601	154,345
	(299,109)	(641,444)	(204,628)
Time at risk (days)	1,941	1,011	1,479
	(782)	(244)	(318)
Number of lots	1.06	1.07	1.02
	(0.54)	(0.77)	(0.20)
Awarding procedure type (%)			
Competitive	10.77%	17.51%	6.20%
Negotiated	46.80%	56.27%	28.71%
Direct	42.29%	26.22%	65.01%
Other	0.15%	0.00%	0.08%
Contract implementation modality (%)			
Standard procurement	89.92%	90.74%	97.51%
Framework agreement	7.88%	8.16%	1.45%
Convention	0.15%	0.08%	0.04%
Concession	0.58%	0.72%	0.40%
PPP/Project finance	0.16%	0.03%	0.00%
In-house management	0.96%	0.00%	0.00%
General contractor	0.30%	0.25%	0.53%
Other	0.05%	0.02%	0.07%
CPV sector (%)			
Construction work	92.13%	97.99%	88.62%
Maintenance	2.34%	0.19%	4.69%
Transport equipment	1.08%	0.13%	2.06%
Energy	0.32%	0.05%	1.27%
Electrical machinery	0.25%	0.05%	0.98%
Other sectors	3.88%	1.59%	2.38%
Main works category (SOA) (%)			
AA	5.52%	2.73%	6.71%
OG1	27.28%	57.16%	20.68%
OG2	5.51%	9.69%	2.74%
OG3	31.98%	13.20%	26.23%
OG10	2.77%	0.33%	13.96%
OG11	2.40%	1.48%	5.46%
OG8	2.28%	1.39%	2.88%
OS24	3.10%	3.03%	0.47%
OS28	1.40%	1.40%	3.27%
OS30	1.54%	0.75%	2.73%
OS6	2.51%	1.50%	3.37%
Other categories	13.71%	7.34%	11.50%

Note: Standard deviations in parentheses for continuous variables. Sample includes public procurement contracts published between January 2016 and December 2023 with contract value above €40,000. NRRP REgular refers to contracts funded by the National Recovery and Resilience Plan (NRRP) that remained active throughout the sample period. NRRP Defunded refers to contracts initially included in the NRRP but classified as defunded in the December 2023 revision.

(award indicator, award-or-start indicator, time to award) or at the implementation phase (work progress and completion).

The indicators NRRP^{+}_{ct} and NRRP^{-}_{ct} distinguish contracts that were (i) funded by the NRRP and never defunded (henceforth - regular NRRP projects), and (ii) initially included in the NRRP but subsequently removed during the December 2023 Plan revision (henceforth - defunded NRRP projects). The vector $\mathbf{X}_{ct}$ collects contract-level controls (lot value, procurement procedure type, contractor selection method, CPV category, SOA work category, and number of lots).[8] The term $f(T_{ct})$ is a quadratic function of the time-at-risk, T_{ct}, defined as the number of days from publication to the end of the observation window. This allows for flexible differential exposure to the "risk" of being awarded or implemented.

Importantly, we include a full set of municipality-by-year fixed effects, α_{it}. These fixed effects absorb *all* shocks and confounders that are common to contracts in the same municipality and calendar year, including: local macroeconomic conditions, changes in political leadership, budgetary constraints, and the aggregate volume of NRRP funding or other concurrent programs. As a consequence, the parameters γ and δ are identified solely from *within* (i, t) cells: they compare NRRP and non-NRRP contracts issued by the same administration in the same year, conditional on $\mathbf{X}_{ct}$ and T_{ct}.

This saturated fixed-effects structure is more demanding than a standard two-way fixed-effects Difference-in-Differences (municipality and year fixed effects). A conventional DiD would rely on cross-municipality time variation in treatment status and would require the existence of non-treated municipalities to serve as controls. In our setting, however, nearly all municipalities are exposed to the NRRP and treatment intensity is highly heterogeneous and continuous. Municipality-by-year fixed effects allow us to circumvent this limitation by dispensing with any cross-municipality "control group" and basing identification on within-cell contract-level contrasts instead.

The regression coefficients γ and δ reflect the effects of different elements of the new NRRP rules for each procurement phase. For the awarding phase, on average, the difference between non-NRRP and NRRP projects (both regular and defunded ones) conflates three arms of the treatment: i) the use of negotiated procedure under extreme urgency circumstances ii) procurement centralization in the hand of the qualified procuring agencies and iii) performance-oriented project management. We attempt to isolate each of these channels

[8] CPV indicates the Common Procurement Vocabulary, that is the European standardized classification system to define public works. SOA (*Societa' organismo di attestazione*) is a compulsory certification that firms must present in order to prove that they have the technical and economic ability to execute public works above certain thresholds.

in our regression analysis. We assess the first channel separately by comparing regression coefficients in (1) with and without the control variable capturing the type of procurement procedure used to award the tender. As for the role of centralization, we isolate its effect by exploring the result heterogeneity between *capoluogo* and not *capoluogo* municipalities, as only the latter were subject to the centralization obligation. Last, the effect for *capoluogo* municipalities, for both regular and defunded NRRP contracts should represent the effect of the performance-oriented project management. Both coefficients γ and δ are expected to be of the same size, as there are no substantial differences in the application of the NRRP system in the awarding phase for regular and to-be-defunded NRRP projects.[9]

For the execution phase, the most relevant elements of the NRRP consist of the application of the performance-based approach that imposed goal-oriented approach stemming from the funding conditionality based on achievement of measurable and measured objectives. Most importantly, it only affected the regular NRRP projects and, therefore, it can be measured by the size of γ coefficient. One can also argue that defunded NRRP projects were subject to a negative shock, for example, due to a "reputation" effect or to the potential uncertainty of the timing of the arrival of the reprogrammed funding. The size of this effect, if present, will be captured by the size of the δ coefficients that measure the procurement execution performance differences between the defunded NRRP and non-NRRP projects.

Weighting and causal interpretation. To ensure valid causal inference, we address potential selection bias arising from non-random assignment of contracts to NRRP funding by employing propensity score reweighting.[10] We implement Average Treatment Effect on the Treated (ATT) weighting, which is particularly appropriate for policy evaluation when the primary interest lies in estimating the effect of the treatment on those units that actually received it (Imbens and Rubin, 2015; Austin, 2011). In order to improve stability and efficiency, we use *stabilized* weights as proposed by Robins et al. (2000); further details regarding the

[9]Note that defunded contracts remained subject to the above regulatory changes in order not to create further legal uncertainty (a large fraction of the defunded projects were already awarded or close to being awarded).

[10]In a similar vein, there is a potentially non-random selection also in the sets of regular and defunded NRRP projects. However, implementing a three-way reweighting strategy is empirically challenging in our setting. First, the set of defunded NRRP projects is substantially smaller and more concentrated in specific sectors, contract sizes, and implementation modalities, which leads to limited common support and unstable weights in multi-valued treatment frameworks. Second, observable pre-treatment characteristics that predict assignment into the NRRP versus non-NRRP groups are not equally informative for distinguishing between active and defunded NRRP projects, whose separation largely reflects program-level revisions rather than ex-ante project features. For this reason, we focus the reweighting procedure on the NRRP versus non-NRRP margin, while controlling flexibly for contract characteristics, procurement procedures, and municipality-by-year fixed effects in all specifications to account for systematic differences between active and defunded NRRP projects.

estimation of the propensity score and the construction of the ATT weights are provided in Appendix A.

Covariate balance resulting from the propensity score reweighting is assessed using standardized mean differences (SMD), computed as:

$$\text{SMD} = \frac{\bar{X}_{\text{NRRP}} - \bar{X}_{\text{control}}}{\sqrt{\frac{s^2_{\text{NRRP}} + s^2_{\text{control}}}{2}}} \tag{2}$$

where $\bar{X}$ denotes group means and s^2 denotes group variances. For categorical variables, we compute SMD for each category indicator. Following standard guidelines (Austin, 2009; Stuart, 2010), we consider balance adequate when $|\text{SMD}| < 0.10$ (good balance) or $|\text{SMD}| < 0.20$ (acceptable balance).

Figure 5.1 presents a "Love plot" displaying standardized mean differences before (red circles) and after (blue triangles) propensity score reweighting for all covariates included in the propensity score model. Each point represents the SMD for a specific covariate or category. The vertical dashed lines at ±0.10 indicate our threshold for good balance.

Overall, the Love plot demonstrates that ATT reweighting successfully balances the treatment and control groups on all pre-treatment covariates, supporting the conditional independence assumption necessary for causal inference. The substantial reduction in SMDs from before to after weighting indicates that our propensity score model adequately captures the selection process into NRRP funding.

The distribution of ATT stabilized weights among control units has the mean of 0.058, the median of 0.054, the maximum of 0.366 and the effective sample size (ESS) of 149,974. The maximum weight of 0.366 is well below the rule-of-thumb threshold of 10, indicating no concerning extrapolation issues. The effective sample size of 149,972 represents 84.02% of the original control group (N=178,489), demonstrating the efficiency in the reweighting procedure. This high efficiency indicates that the propensity score model successfully identifies a large pool of control units with characteristics similar to the treated group, ensuring robust estimation of treatment effects without excessive reliance on a small number of heavily weighted observations.

The validity of our ATT estimates relies on two key assumptions:

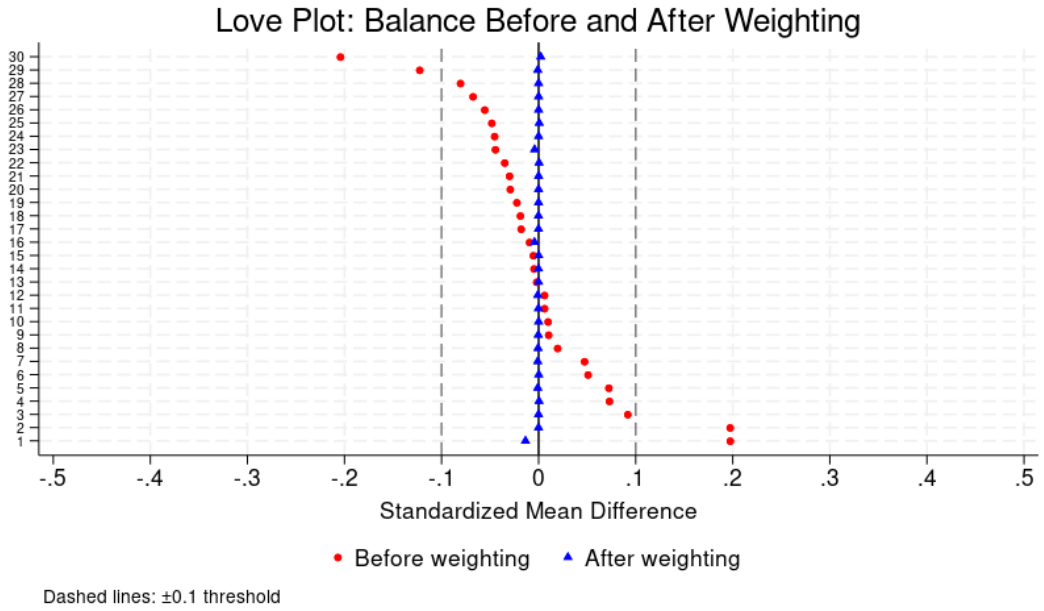
1. **Conditional independence**: Conditional on observed covariates, NRRP assignment is independent of potential outcomes. This assumption is supported by the institutional knowledge that NRRP assignment was based primarily on project characteristics, which

are captured in our covariates.

2. **Common support**: There exists overlap in the covariate distributions between treated and control groups. This is ensured through our explicit common support restriction and verified through propensity score distribution plots.

While we cannot directly test the conditional independence assumption, the achieved balance across a comprehensive set of pre-treatment characteristics provides strong evidence that our reweighting strategy successfully addresses observed confounding. Remaining concerns about unobserved confounding are partially addressed through our within-municipality fixed effects specifications, which absorb time-invariant municipal characteristics that might affect both NRRP assignment and procurement outcomes.

Figure 5.1: Balance Assessment: Standardized Mean Differences Before and After Propensity Score Reweighting



Note: The Love plot displays standardized mean differences (SMD) between NRRP-funded and non-NRRP contracts for all covariates included in the propensity score model. Red circles show SMD before reweighting (raw differences), and blue triangles show SMD after ATT reweighting. Vertical dashed lines at ±0.10 indicate the threshold for good balance. Covariates are ordered by raw (pre-weighting) SMD magnitude. The substantial convergence of SMDs toward zero after reweighting demonstrates successful balance achievement across all covariates. All post-weighting SMDs fall within the acceptable range ($|SMD| < 0.10$).

Second step: municipality-level spillovers. The estimated fixed effects $\hat{\alpha}_{it}$ from the first step can be written as

$$\hat{\alpha}_{it} \approx \mathbb{E}[Y_{cit} \mid i,t] - \gamma\, \mathbb{E}\big[\text{NRRP}_c^{+} \mid i,t\big] - \delta\, \mathbb{E}\big[\text{NRRP}_c^{-} \mid i,t\big] - \mathbb{E}\big[\boldsymbol{\eta}'\mathbf{X}_c + f(T_c) \mid i,t\big]\,.$$

They summarize the average procurement performance of municipality i in year t *after* netting out direct NRRP status effects and contract-level composition. We interpret $\hat{\alpha}_{it}$ as a municipality-year–specific performance component, capturing local administrative capacity in procurement management for all non-NRRP projects.

In the second stage, we relate these municipality-year procurement performance measures to pre-determined measures of NRRP exposure:

$$\hat{\alpha}_{it} = \mu_i + \lambda_t + \sum_{\tau \neq 2020} \beta_\tau \left(D_i \times \mathbf{1}[t = \tau]\right) + u_{it}\,, \tag{3}$$

where D_i is a is a time-invariant measure of realized exposure to the NRRP, defined as the ratio between the total number (or value) of NRRP-funded contracts awarded in municipality i over the sample period and the stock of pre-NRRP contracts. The denominator uses only pre-NRRP contracts and normalizes exposure by the pre-existing size of the local procurement market. μ_i are municipality fixed effects, and λ_t are year fixed effects. The interaction terms $D_i \times \mathbf{1}[t = \tau]$ allow the effect of pre-existing exposure to evolve over time, with 2020 as the omitted baseline year.

Equation (3) is formally analogous to an event-study Difference-in-Differences specification with a continuous treatment "dose": the coefficients β_τ compare the evolution of $\hat{\alpha}_{it}$ in more exposed municipalities (high D_i) relative to less exposed ones (low D_i), after purging time-invariant municipal heterogeneity and common aggregate shocks.

The second-stage coefficients measuring the *spillover effect* (β_τ) capture how NRRP exposure affects the municipality-year performance component $\hat{\alpha}_{it}$ for non-NRRP contracts. This is interpreted as a spillover from NRRP onto local administrative capacity, organizational learning, and resource allocation. For example, the adoption of performance-oriented management practices may spillover also on contracts not directly monitored through the NRRP scheme due to learning. In a similar vein, additional human resources recruited to support public administrations in the NRRP management may be freely allocated within the organization and contribute to the improved performance of all contracts, beyond those directly included in the Plan.

Compared to a conventional DiD design, our approach offers two key advantages in this

setting. First, the use of municipality-by-year fixed effects in the first stage removes the need for a clean group of never-treated municipalities, which is effectively absent given the pervasive and heterogeneous nature of NRRP funding. Second, the two-stage structure allows us to simultaneously recover contract-level treatment effects (micro-level channels γ and δ) and municipality-level spillovers (macro-level channel β_τ) within a unified and internally consistent framework.

The second-stage coefficients β_τ are identified under the assumption that, absent the NRRP, municipalities with different pre-treatment exposure D_i would have experienced parallel trends in the municipality-year performance component $\hat{\alpha}_{it}$. Formally, D_i is a time-invariant municipality-level variable that summarizes the *realized* intensity of NRRP funding relative to the pre-NRRP procurement volume. Our identification relies on the assumption that, absent the NRRP, municipalities with different values of D_i would have experienced similar trends in the municipality-year performance component $\hat{\alpha}_{it}$, once we control for municipality and year fixed effects. We assess the plausibility of this assumption by estimating equation (3) in the pre-NRRP period and showing that the coefficients for $\tau < 2021$ are statistically indistinguishable from zero.

Finally, because the second stage uses $\hat{\alpha}_{it}$—a generated regressor obtained from the first-stage regression—standard errors in equation (3) must be robust to this two-step structure. In practice, the first stage is estimated on a very large number of contracts, so the estimation error in $\hat{\alpha}_{it}$ becomes negligible relative to sampling variation at the municipality-year level. We nonetheless cluster standard errors at the municipality level in both stages, so inference is robust to arbitrary serial correlation and heteroskedasticity within municipalities over time.

6 Direct effects of the NRRP

First, we investigate the effects of the NRRP on the variables reflecting the performance and speed in the awarding phase in Table 6.1. Each row corresponds to regressions as in equation (1) with a different outcome variable; each pair of columns shows the coefficients of interest reflecting performance differences between non-NRRP (reference category) and regular and defunded NRRP contracts.

The effect of the application of the NRRP rules is overall positive for the awarding probability (row 1). It amounts to a 19 percentage points' higher probability of awarding, that is equivalent to 10 days (row 3). The effect of a virtually identical magnitude both for regular and defunded NRRP projects is reassuring, as the awarding phase was carried out under identical rules for the vast majority of both types of projects. By measuring the awarding

Table 6.1: Direct effects: Awarding

	Baseline		Procedural discretion		Centralization		Performance	
	γ	δ	γ	δ	$\gamma \times$ NCP	$\delta \times$ NCP	γ	δ
Awarded (0/1)	0.19***	0.19***	0.19***	0.19***	0.06**	0.08***	0.15***	0.13***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.02)	(0.02)	(0.02)	(0.02)
Started or awarded (0/1)	0.12***	0.13***	0.12***	0.13***	0.04**	0.06***	0.09***	0.08***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.02)	(0.02)	(0.02)	(0.02)
Days to award	-10.22***	-10.23***	-6.32***	-12.47***	3.25	3.06	-12.68***	-13.06***
	(1.52)	(0.70)	(1.60)	(0.73)	(3.86)	(3.40)	(3.46)	(3.32)
Municip.×Year FE + controls + ATT weights	Yes		Yes		Yes		Yes	
Observations – Awarded	192,756		192,756		167,197		167,197	
Observations – Started or awarded	192,756		192,756		167,197		167,197	
Observations – Days to award	140,653		140,653		122,715		122,715	

Notes: Entries report average treatment effects on the treated (ATT) from contract-level regressions with municipality×year fixed effects. Standard errors (in parentheses) are clustered at the municipality level. *Performance* reports direct coefficients on NPRR^{+} and NPRR^{-} for *capoluoghi* (reference category). *Centralization* reports interaction coefficients capturing the extra effect for non-*capoluogo* municipalities (e.g., $\hat{\gamma}^{NC} - \hat{\gamma}^{C}$ and $\hat{\delta}^{NC} - \hat{\delta}^{C}$). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

success using the indicator that a given tender is either awarded or has on open worksite (information recovered from the ANCE data, row 2), the premium amounts to 12 percentage points.

As discussed in more detail in Section 5, there are several elements that distinguish the management of NRRP projects with respect to non-NRRP ones: i) the procedural discretion justified under extreme urgency circumstances, ii) centralization mandate for non-provincial capital municipalities, and iii) performance-oriented project management.

To attempt to disentangle these different arms of the new NRRP rules, we resort to different regression specifications. In particular, in Table 6.1 columns 3 and 4 replicate the same specification with the exclusion of procurement procedure type controls; columns 5 and 6 show the coefficients on the regular and defunded NRRP contract dummies interacted with not-*capoluogo* indicators, while columns 7 and 8 - their main effect.

Columns 3 and 4 for the two indicator variables that capture the probability of successful award show that the coefficients are virtually the same. Given the insensitivity of the results to controlling for this channel, we conclude that the possibility of the discretionary use of the negotiated procedure did not contribute significantly to the awarding success of the Plan's projects.

We then disentangle between effects of centralization and performance orientation. The

results reveal that while delegation of contract awarding to competent administration results in a 6 percentage points higher probability of awarding (columns 5), the largest contribution stems from the performance-oriented approach to managing public procurement projects that raises that probability by 15 percentage points (column 7). The effects are qualitatively similar also for the defunded NRRP projects shown in columns 6 and 8.

The empirical patterns in regressions with the alternative definition of the awarding success are qualitatively similar, while in those with the duration of the awarding procedure the centralization effects seem to be rather limited as indicated by a positive, but statistically insignificant regression coefficient. This is likely reflecting the fact that delegating procedures to the qualified procurement agencies mostly affected the probability of awarding, rather than - conditional on concluding the procedure - its duration.

Next, Table 6.2 focuses on the project implementation stage, with different rows correspond to the probability of starting the related works (i.e. opening of at least one project-related worksite), the continuous measure of project progress and measures of the first, advanced and almost finished worksite progress based on the usage of the predicted labor input for a given project (for more details, see Table B.1 with the variable descriptions). As discussed in Section 3, the first channel possibly affecting the project execution stage acts upon the incentives of the public administration and stems from the performance-oriented approach pushing public administration to monitor worksites and avoid administrative bottle-necks that could up the project execution. The second channel instead provides conditions for private contractors to swiftly start the project by injecting a higher liquidity upon the signing of the contract in the form of an advance payment. Both of the channels affect the regular NRRP projects, while none are active for defunded projects. The latter, however, could suffer from disruptive effects due to the uncertainty of financing.

The results in Table 6.2 column 1 indicate that the positive NRRP effect on the opening of the worksite and on the subsequent steps of the project's progress, on the continuous measure of the progress and on its different "steps". The effect, however, seems to diminish gradually once we get closer to the end of the project; in particular, it is no longer significant on the highest progress measure.[11] Since the advance payment primarily affects the initial phase of project implementation, one interpretation of these results is that a key component of the NRRP's impact on execution outcomes operates through this upfront financing mechanism. We further corroborate this idea by exploiting the fact that the advance payment raise from 10% to 30% became active starting from 2024. In columns 3 and 4 of Table 6.2 we exploit this

[11] In interpreting this result, we should keep in mind that, by construction, the continuous measure of progress becomes more imprecise the further the execution stage.

feature and interact the coefficient γ with the indicator for the projects tendered in 2023 or later, the execution of which likely started under the higher advance payment regime.[12] The positive and statistically significant coefficient on the project start indicator for projects that benefited from the larger advance payment confirms the idea that earlier liquidity injection may alleviate some frictions on the private contractors' side.

The coefficients on the defunded NRRP projects are mostly negative (Table 6.2, column 2), and the negative performance appears to slightly amplify moving towards the more advanced stages of the project implementation. This, indeed, confirms that the defunding of the projects originally assigned to the Plan carries a detrimental effect on their progress, both due to the higher uncertainty of the funds that suddenly need to be allocated for the defunded projects and, possibly, to the selection effects whereby projects with the lower ex-ante success probability may have been removed from the Plan.[13]

Heterogeneity. We next investigate whether the NRRP effects differ by municipal administrative capacity which we proxy by the Municipal Administrative Quality Index (MAQI), developed by Cerqua et al. (2025). MAQI is a composite index based on 11 indicators that capture multiple dimensions of local administrative quality and capacity. The index aggregates information along three main pillars: (i) *bureaucratic efficiency and capacity*, reflecting the structural characteristics of the municipal administration (e.g., average years of education of public employees, personnel turnover); (ii) *quality of local politicians*, capturing the human capital and professionalism of the political leadership; and (iii) *fiscal and economic performance*, measuring financial management and investment capacity (e.g., revenue collection ability and expenditure rigidity). To ensure that administrative capacity is predetermined with respect to NRRP implementation, we use the pre-NRRP MAQI, computed as the average value over the 2018–2019 period. Municipalities are classified as *low-* or *high-capacity* based on whether their pre-NRRP MAQI lies below or above the sample median.

Tables 6.3 and 6.4 explore how the effects of the NRRP vary with pre-existing municipal

[12] In practice, all NRRP-projects could access this advance payment even if they were awarded well before 2024. In this exercise, we assume that projects tendered in 2023 were more likely to be in an initial stage and could benefit more from this initiative.

[13] However, the suggestive evidence does not lend itself well to the latter interpretation. The re-modelling of the Plan appears to have been driven only marginally by evidence on project-level delays; rather, it largely reflected administrative and regulatory constraints. In particular, significant difficulties emerged in ensuring compliance with specific requirements—most notably the Do No Significant Harm (DNSH) principle—for projects that had been conceived prior to the drafting of the Plan. Additional concerns related to the monitoring burden associated with a very large number of small-scale interventions managed by local authorities. Consistently with this interpretation, the revision predominantly preserved projects managed by central administrations—even when characterized by comparatively slower progress—while a substantial share of local projects, often displaying more advanced implementation stages, was defunded.

Table 6.2: Direct effects on project execution

	Baseline		With Post2023 interaction	
	γ	δ	γ	$\gamma \times$ Post2023
Started (0/1)	0.07***	-0.01	0.02	0.08***
	(0.01)	(0.00)	(0.02)	(0.02)
Any progress (SAL_all)	0.03***	-0.02***	0.02	0.01
	(0.01)	(0.00)	(0.02)	(0.02)
First progress (≥ 0.25)	0.05***	-0.01**	0.03*	0.04**
	(0.01)	(0.00)	(0.02)	(0.02)
Advanced (≥ 0.50)	0.03***	-0.02***	0.03*	0.00
	(0.01)	(0.00)	(0.02)	(0.02)
Almost closed (≥ 0.75)	0.01	-0.02***	0.02	-0.02
	(0.01)	(0.00)	(0.02)	(0.02)
Municipality×Year FE + controls + ATT weights			Yes	
Observations			192,756	

Notes: Baseline columns report coefficients γ (NRRP$^+$) and δ (NRRP$^-$). Interaction columns report γ and its interaction with Post2023 (dummy equal to one if the tender was published in 2023 or later). All specifications include municipality×year fixed effects and the full set of contract-level controls. Standard errors (in parentheses) are clustered at the municipality level. SAL measures cumulative physical progress of works. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

administrative capacity using the overall index and exploiting information on its different pillars.

In the awarding phase, the effects of NRRP exposure on the probability of awarding a contract are larger in low-capacity municipalities. Both the *Awarded* and *Awarded or started* outcomes exhibit stronger treatment effects for low-capacity administrations, with the estimated coefficients for active and defunded NRRP contracts being virtually identical within each capacity group. This pattern is consistent with the interpretation that, at the awarding stage, the NRRP primarily operates through friction-reducing organizational and governance channels—such as performance-oriented tendering and procurement centralization—which substitute for weaker administrative capacity and raise the likelihood of successfully concluding procurement procedures.

In contrast, heterogeneity in the execution phase points to complementarities between administrative capacity and NRRP induced organization changes that regard project execution, although evidence is somewhat weaker: the positive effects of active NRRP contracts on project progress are more pronounced and more precisely estimated in high-capacity municipalities compared to those with low administrative competence. The defunded NRRP

projects, instead, display negative effects on execution outcomes that are relative more severe among low-capacity municipalities.

Table 6.3: The NRRP and Administrative Capacity

	Low capacity		High capacity	
Outcome	γ	δ	γ	δ
Awarded	0.23***	0.23***	0.18***	0.18***
	(0.02)	(0.01)	(0.01)	(0.01)
Awarded or started	0.14***	0.15***	0.11***	0.12***
	(0.02)	(0.01)	(0.01)	(0.01)
Awarding time (days)	-9.74***	-8.27***	-10.50***	-10.94***
	(3.21)	(1.30)	(1.80)	(0.92)
Started (0/1)	0.07***	-0.01	0.07***	-0.00
	(0.02)	(0.01)	(0.01)	(0.01)
SAL_all	0.02	-0.02***	0.03***	-0.01**
	(0.02)	(0.01)	(0.01)	(0.01)
SAL_all ≥ 0.25	0.05**	-0.01***	0.05***	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)
SAL_all ≥ 0.50	0.03	-0.02**	0.04***	-0.01*
	(0.02)	(0.01)	(0.01)	(0.01)
SAL_all ≥ 0.75	0.01	-0.03***	0.01	-0.02***
	(0.02)	(0.01)	(0.01)	(0.01)

Notes: γ and δ report ATT estimates for NPRR^{+} (active) and NPRR^{-} (defunded) from contract-level regressions with municipality×year fixed effects and contract-level controls. Standard errors clustered at the municipality level in parentheses. Low- and high-capacity municipalities are defined by the median of the pre-NPRR MAQI.
Observations: 52,330 (low capacity) and 117,839 (high capacity) for all outcomes except *Awarding time*: 33,872 (low) and 89,639 (high).
Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Next, we exploit the information on municipal scores in each of MAQI's distinct pillars to shed further light on the effectiveness of the new NRRP rules in Table 6.4. In particular, we replicate the heterogeneity analysis splitting the sample by low and high performance in bureaucratic efficiency and administrative capacity (Pillar 1, columns 1-4); political leadership quality (Pillar 2, columns 5-8) and fiscal and economic performance (Pillar 3, columns 9-12).

The evidence regarding the award stage confirms the pattern observed for the composite index, whereby the new NRRP rules are more effective for low capacity municipalities. Interestingly, further heterogeneity emerges in the execution stage: the NRRP effects are substantially stronger among municipalities with higher scores in political leadership quality

and those with higher bureaucratic and administrative efficiency. The heterogeneity is much weaker (and if anything reversed) between public bodies with high and low scores in fiscal and economies performance. Overall, this evidence is consistent with the interpretation that performance-oriented project management —- one of the key features distinguishing execution of active NRRP projects -— translate into more sustained execution pace only where administrative systems are sufficiently equipped to successfully adopt these innovations.

The results sharpen the interpretation of the mechanisms discussed in the main analysis, highlighting the presence of substitutability between the NRRP levers and administrative capacity in the awarding stage and that of complementarities in the execution stage. This is intuitive given the clear distinction between distinct elements applied in each of the phases and provides grounds to form evidence-based policy implication beyond the scope of the specific NRRP case.

Table 6.4: NRRP Effects by Pillars

	Pillar 1				Pillar 2				Pillar 3			
	Low		High		Low		High		Low		High	
Outcome	δ	λ	δ	λ	δ	λ	δ	λ	δ	λ	δ	λ
Award Stage												
Awarded	0.22***	0.22***	0.17***	0.18***	0.20***	0.22***	0.19***	0.19***	0.21***	0.22***	0.17***	0.18***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Awarded or started	0.14***	0.15***	0.11***	0.12***	0.12***	0.14***	0.12***	0.12***	0.13***	0.15***	0.11***	0.11***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Awarding time	-7.76***	-11.70***	-11.20***	-9.00***	-9.64***	-7.68***	-10.47***	-11.39***	-12.94***	-10.96***	-6.92***	-9.90***
	(2.74)	(1.04)	(1.92)	(1.04)	(3.12)	(1.18)	(1.81)	(0.95)	(2.22)	(1.24)	(2.22)	(0.83)
Implementation Stage												
Started	0.08***	-0.02**	0.07***	0.01	0.05***	-0.00	0.08***	-0.01	0.08***	0.00	0.07***	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
SAL_all	0.02	-0.03***	0.04***	-0.00	0.01	-0.01*	0.04***	-0.02***	0.04***	-0.02**	0.03**	-0.01**
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Closed $\geq$ 0.25	0.05***	-0.03***	0.06***	0.00	0.04*	-0.01	0.06***	-0.01*	0.06***	-0.01	0.05***	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Closed $\geq$ 0.50	0.03	-0.03***	0.04***	-0.00	0.02	-0.02***	0.04***	-0.02***	0.04***	-0.02**	0.03*	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Almost closed $\geq$ 0.75	0.00	-0.04***	0.02	-0.01	0.01	-0.02***	0.02	-0.02***	0.01	-0.02***	0.01	-0.02***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)

Notes: The table reports ATT estimates from contract-level regressions with municipality×year fixed effects. The coefficients γ (δ) measure the effect of active NRRP contracts, while δ (NRRP$^-$) measure the effect of NRRP contracts that were defunded in December 2023, both relative to non-NRRP contracts within the same municipality-year. Regressions include contract-level controls (lot amount, awarding procedure, implementation modality, CPV sector, SOA category, number of lots) and a quadratic function of time-at-risk. Controls are reweighted using stabilized ATT weights based on the propensity score. Standard errors clustered at the municipality level are reported in parentheses. Low and High capacity municipalities are defined using the median of the pre-NRRP (2018–2019) value of each MAQI pillar separately. Pillar 1 captures bureaucratic efficiency and administrative capacity; Pillar 2 captures political leadership quality; Pillar 3 captures fiscal and economic performance. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

7 Spillover effects of the NRRP

We analyze whether the application of the new NRRP rules had an impact beyond direct effect on the NRRP projects that were managed under a different regulatory and "managerial" framework compared to the regular ones. Positive spillovers in the administrative activity may arise from learning or the injection of new or re-allocation of existing resources. On the other hand, non-NRRP projects may progress more sluggishly because regular administrated activity is crowded out by the prioritized NRRP projects.

Table 7.1 column 1 shows the estimates on the coefficient of the NRRP exposure for different awarding success variables, from the equation (3). We are, however, unable to directly disentangle between the contributions of each single factor and leave the deeper analysis of the generic capacity building for the future research, where ideally longer term post-NRRP municipal performance outcomes can be measured.

We next dwell into the analysis of how the NRRP experience interacts with the characteristics of the procuring agencies. The distinction between low and high MAQI municipalities (columns 2 and 3, respectively) shows that spillover effects are non-negative even among the low capacity public administrations, where the additional resources injected due to the NRRP likely plays an important role, and, if anything, are stronger among municipalities with higher reception potential. All in all, this evidence suggest the lack of negative NRRP effects on the municipal procurement activity, likely because of the Plan's generous injection of the resources to enable public administrations to deal with the unprecedented quantity and type of activity.

Our baseline identification strategy compares NRRP and non-NRRP contracts within the same municipality-year, implicitly treating non-NRRP contracts as untreated controls. The evidence that the new NRRP rules generate within-municipality spillovers indicates that the SUTVA is possibly violated: the control group is partially treated and appears to benefit from the NRRP organization changes. As a consequence, the estimated direct effects on procurement outcomes should be interpreted as a lower bound of the total impact of the NRRP, since the counterfactual outcome is itself improved by spillovers.

8 Robustness

This section assesses the robustness of our empirical design and main findings. We examine whether the estimated direct effects of the NRRP at the contract level and the indirect spillover effects at the municipality level are sensitive to alternative weighting schemes, treatment

Table 7.1: Indirect (spillover) Effects on Administrative Activity

Outcome	Baseline	Low capacity	High capacity
Awarded	0.03***	0.02*	0.03**
	(0.01)	(0.01)	(0.01)
Awarded/started	0.03***	0.02*	0.03**
	(0.01)	(0.01)	(0.01)
Awarding time (days)	1.25	-0.66	2.32
	(1.32)	(2.01)	(1.78)
Municipality and period FE	Yes	Yes	Yes
Observations (municipality-period)	12,264	5116	6108

Notes: The dependent variable is the municipality–period fixed effect estimated in first-stage contract-level regressions. Coefficients report estimates of `dose_pre` × Post, where Post equals one for years ≥ 2021. All specifications absorb municipality and period fixed effects. Standard errors clustered at the municipality level are reported in parentheses. Low- and high-capacity municipalities are defined based on the median of the pre-NPRR MAQI.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

classifications, exposure measures, and identifying assumptions. We also probe potential violations parallel trends. Across all exercises, the results remain qualitatively stable. All additional tables and figures are reported in the Appendix.

We first examine the sensitivity of the contract-level estimates to the weighting procedure. In the baseline specification, we use stabilized ATT weights derived from a propensity score estimated on pre-treatment contract characteristics. Stabilization reduces the variance of weights and improves finite-sample precision, but does not alter identification. To verify that our findings are not driven by this normalization, we re-estimate all first-step regressions using non-stabilized ATT weights. Appendix Table B.1 shows that both awarding and execution effects are qualitatively unchanged in magnitude and statistical significance, indicating that the estimated direct effects are not driven by the specific normalization of the weights.

We then assess whether the spillover results depend on the definition of treatment intensity. In the baseline specification, exposure is defined using the total value of NRRP contracts relative to pre-NRRP procurement activity, capturing the financial intensity of the program within each municipality. As a robustness check, we redefine exposure using the number of NRRP contracts instead of their total amount. Appendix Table B.4 shows that spillover estimates remain stable under this alternative definition.

Third, we address the potential confounding role of the Fund for Non-deferrable Projects

(*Fondo per le Opere Indifferibili*, FOI), which provided reserve-price support in response to cost shocks. If FOI disproportionately facilitated participation or award feasibility, part of the estimated NRRP effect could reflect this channel rather than the governance model itself. We therefore re-estimate the main specifications explicitly controlling for FOI exposure. Appendix Table B.6 shows that the core results are unaffected.

Fourth, we reconsider the classification of contracts published in 2020. Although formally part of the NRRP timeline, projects tendered in 2020 may not have fully benefited from the NRRP management method, particularly in the awarding phase, given the gradual institutional rollout. We therefore reclassify 2020 NRRP contracts as non-NRRP and re-estimate the baseline models. As reported in Appendix Table B.7, the estimated award effects increase in magnitude once 2020 contracts are excluded from treatment. This pattern is consistent with the hypothesis that early projects were only partially exposed to the new governance framework, implying that the baseline estimates may understate the full effect of the new NRRP rules.

Turning to the spillover design, we test the parallel-trends assumption using an event-study specification interacting predetermined exposure with year indicators. Appendix Figure C.1 and Table B.8 shows no differential pre-trends prior to 2020, while divergence emerges only after the NRRP becomes operational. Similar patterns hold across administrative-capacity strata and MAQI components (Appendix Figures C.2 - C.5 and Table B.9 - B.12), supporting the identifying assumption underlying the second-stage estimates.

We also investigate the orthogonality of exposure to ex-ante administrative capacity. If municipalities with higher MAQI systematically attracted more NRRP resources, exposure could proxy for baseline quality rather than program-induced organizational change. We therefore regress the exposure measure on pre-NRRP MAQI and other baseline procurement characteristics. Appendix Table B.13 shows that once conditioning on pre-period controls, the association between exposure and MAQI is weak and statistically insignificant. This supports the interpretation that spillover effects are not simply driven by pre-existing institutional differences.

Finally, we assess the sensitivity of the heterogeneity results to alternative definitions of administrative capacity. The baseline MAQI measure averages 2018–2019 values. We replicate the analysis using MAQI measured in 2018 only, in 2019 only, and over a longer pre-period window (2016–2019). We also use municipality population size as a simpler proxy for capacity, splitting municipalities above and below the median population. Appendix Tables B.14 and B.15 show that the qualitative patterns are stable across definitions.

9 Concluding remarks

In this paper, we analyze the effects of the organizational innovations introduced by the Italian NRRP on the performance of public works procurement.

Our results indicate that the NRRP increased the likelihood that a tender is awarded by 19 percentage points and reduced awarding time by approximately 10 days. These positive effects are largely driven by the Plan's performance-oriented approach, which entailed a credible threat of defunding if projects were not completed on time. The centralization of procurement in the hands of more qualified agencies further amplified these effects, while higher procedural discretion played only a limited role. The positive impact of the NRRP in the awarding stage is stronger for administrations characterized by lower pre-treatment administrative capacity, suggesting that NRRP rules effectively alleviated pre-existing administrative frictions.

The impact of the NRRP on the execution phase is more nuanced. We find that more generous advance payments had a positive effect in the initial stages of construction, but this effect fades over the life cycle of the project. The positive impact is stronger and more persistent for high-capacity administrations, pointing to a complementarity between the speed of execution by private firms and the ability of public administrations to effectively monitor project implementation.

Finally, we find no evidence that NRRP-funded procurement displaced non-NRRP contracts. This result may reflect both the increase in human resources allocated to NRRP-intensive municipalities and a learning process among more exposed administrations.

These findings have important implications for the design of a more effective procurement system. First, they underscore the value of performance-based governance mechanisms – particularly credible enforcement through the threat of defunding – in accelerating procurement outcomes. Second, they suggest that centralizing procurement functions within more qualified agencies can yield efficiency gains, especially in contexts with weak administrative capacity, although such centralization alone is not transformative. Third, the results point to the importance of establishing a robust monitoring system that actively involves the private sector: advance payments can accelerate execution only in the initial stages, and credible enforcement mechanisms or performance incentives should also extend to private contractors. Finally, the absence of displacement effects indicates that large-scale investment programs can expand overall procurement activity, provided they are supported by sufficient administrative resources and capacity-building initiatives.

References

P. C. Austin. Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples. *Statistics in Medicine*, 28 (25):3083–3107, 2009.

P. C. Austin. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioral Research*, 46(3):399–424, 2011.

A. Baltrunaite, S. Mocetti, and G. Rovigatti. Administrative capacity in public procurement: Evidence and mechanisms. CEPR Working paper 20774, 2025.

O. Bandiera, A. Prat, and T. Valletti. Active and passive waste in government spending: evidence from a policy experiment. *American Economic Review*, 99(4):1278–1308, 2009.

K. Bańkowski, N. Benalal, O. Bouabdallah, R. De Stefani, C. Dorrucci, Ettore amd Huber, P. Jacquinot, W. Modery, C. Nerlich, M. Rodríguez Vives, B. Szörfi, N. Zorell, and C. Zwick. Four years into nextgenerationeu: What impact on the euro area economy. ECB Occasional Paper 362, European Central Bank, 2024.

T. Besley and T. Persson. The origins of state capacity: Property rights, taxation, and politics. *American Economic Review*, 99(4):1218–44, September 2009. doi: 10.1257/aer.99.4.1218. URL https://www.aeaweb.org/articles?id=10.1257/aer.99.4.1218.

T. Besley and T. Persson. Pillars of prosperity. 2013.

N. Bloom and J. Van Reenen. Measuring and explaining management practices across firms and countries. *The quarterly journal of Economics*, 122(4):1351–1408, 2007.

N. Bloom, C. Propper, S. Seiler, and J. V. Reenen. The impact of competition on management quality: Evidence from public hospitals. *The Review of Economic Studies*, 82 (2):457–489, None 2015. doi: None. URL https://ideas.repec.org/a/oup/restud/v82y2015i2p457-489.html.

N. Bloom, R. Lemos, R. Sadun, and J. V. Reenen. Healthy business? managerial education and management in health care. *The Review of Economics and Statistics*, 102 (3):506–517, July 2020. doi: None. URL https://ideas.repec.org/a/tpr/restat/v102y2020i3p506-517.html.

V. Bucci, L. Bugiaretti, S. Gatteschi, and F. Rotondo. Performance-based programs and efficiency in public investment: Some evidence from italy's national recovery and resilience plan. Cdp working paper, Cassa Depositi e Prestiti, 2026.

S. S. Camera dei deputati. Monitoraggio del piano nazionale di ripresa e resilienza. Dossier xix legislatura, Roma, 2025. URL https://documenti.camera.it/leg19/dossier/pdf/DFP28j.pdf.

S. A. M. Camussi, D. Dottori, M. Mancinelli, A. L. Mancini, F. Modena, P. Recchia, E. Russo, and G. M. Tanzi. The employment activated by the national recovery and resilience plan in the construction sector at the regional level. *Journal of Industrial and Business Economics*, 51(2):299–324, 2024.

A. Cerqua, C. Giannantoni, F. Zampollo, and M. Mazziotta. The municipal administration quality index: the italian case. *Social Indicators Research*, 177(1):345–378, 2025.

S. r. i. s. d. c. Corte dei Conti. Stato di attuazione del piano nazionale di ripresa e resilienza (pnrr). Relazione, 2025.

F. Corti and P. Vesan. From austerity-conditionality towards a new investment-led growth strategy: Social europe after the recovery and resilience facility. *Social Policy & Administration*, 57(4):513–548, 2023. doi: https://doi.org/10.1111/spol.12906. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/spol.12906.

D. Coviello, A. Guglielmo, and G. Spagnolo. The effect of discretion on procurement performance. *Management Science*, 64(2):715–738, 2018.

E. Dal Bó, F. Finan, and M. Rossi. Strengthening state capabilities: The role of financial incentives in the call to public service. *The Quarterly Journal of Economics*, 128(3):1169–1218, 2013. URL https://EconPapers.repec.org/RePEc:oup:qjecon:v:128:y:2013:i:3:p:1169-1218.

F. Decarolis, R. Fisman, P. Pinotti, and S. Vannutelli. Rules, discretion, and corruption in procurement: Evidence from italian government contracting. *Journal of Political Economy Microeconomics*, 3(2):213–254, 2025.

E. Deserranno. Financial incentives as signals: Experimental evidence from the recruitment of village promoters in uganda. *American Economic Journal: Applied Economics*, 11(1):277–317, January 2019. doi: 10.1257/app.20170670. URL https://www.aeaweb.org/articles?id=10.1257/app.20170670.

A. Dixit. Incentives and organizations in the public sector: An interpretative review. *Journal of human resources*, pages 696–727, 2002.

N. Dwenger and A. Gumpert. Building capacity in the public administration: Evidence

from german reunification. CESifo Working Paper Series 12345, CESifo, 2025. URL https://ideas.repec.org/p/ces/ceswps/_12345.html.

European Council. Council implementing decision of 13 july 2021 on the approval of the assessment of the recovery and resilience plan for italy. Implementing Decision 10160/21, European Council, 2021. URL https://data.consilium.europa.eu/doc/document/ST-10160-2021-INIT/en/pdf.

European Council. Council implementing decision (eu) 2023/2761 of 8 december 2023 amending implementing decision (eu) 2021/1195 on the approval of the assessment of the recovery and resilience plan for italy. Implementing Decision L, 2023/2761, Official Journal of the European Union, 2023. URL https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023D2761.

European Union. Regulation (eu) 2021/241 of the european parliament and of the council of 12 february 2021 establishing the recovery and resilience facility. Regulation L 57/17, Official Journal of the European Union, 2021. URL https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32021R0241.

R. Fantozzi and S. Gabriele. Il pnrr e la riorganizzazione del servizio sanitario nazionale. Focus tematico 3, Ufficio Parlamentare di Bilancio, Roma, 2025. URL https://www.upbilancio.it/wp-content/uploads/2025/05/Focus-3_2025_PNRR_sanita.pdf.

G. Ferri, M. Menghini, and M. Pini. Does the nrrp speed up firms' twin transition? empirical evidence from italy. Ministry of Economy and Finance Working Paper 3, Ministry of Economy and Finance, 2023.

S. Gagliarducci and T. Nannicini. Do better paid politicians perform better? disentangling incentives from selection. *Journal of the European Economic Association*, 11(2):369–398, 2013.

G. F. Gori, P. Lattarulo, and N. C. Salerno. L'efficienza temporale nella realizzazione delle opere pubbliche in italia. Nota di lavoro 2/2022, Ufficio Parlamentare di Bilancio (UPB), 07 2022. URL https://www.upbilancio.it.

G. F. Gori, P. Lattarulo, M. R. Marino, and N. C. Salerno. La riforma del codice dei contratti e la rimodulazione del pnrr: impatto sugli appalti pubblici e sui tempi di realizzazione delle opere. Nota di lavoro 2/2024, Ufficio Parlamentare di Bilancio (UPB), 12 2024. URL https://www.upbilancio.it. Pubblicato il 12 dicembre 2024.

Governo Italiano. Decreto-legge 31 maggio 2021, n. 77, "governance del piano nazionale di ripresa e resilienza e prime misure di rafforzamento delle strutture amministra-

tive e di accelerazione e snellimento delle procedure". Decreto-legge, Gazzetta Ufficiale, 2021. URL https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legge:2021-05-31;77. Convertito con modificazioni dalla Legge 29 luglio 2021, n. 108.

Governo Italiano. Decreto legislativo 31 marzo 2023, n. 36, "codice dei contratti pubblici in attuazione dell'articolo 1 della legge 21 giugno 2022, n. 78". Decreto legislativo, Gazzetta Ufficiale, 2023. URL https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2023-03-31;36.

G. W. Imbens and D. B. Rubin. *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*. Cambridge University Press, 2015.

C. Leaver, R. Lemos, and D. Scur. Understanding school management with public data: A new measurement approach and applications. CEPR Working paper 14069, 2024.

R. Lemos, K. Muralidharan, and D. Scur. Personnel management and school productivity: Evidence from india. *The Economic Journal*, 134(661):2071–2100, 2024. URL https://EconPapers.repec.org/RePEc:oup:econjl:v:134:y:2024:i:661:p:2071-2100.

L. Mauro and F. Pigliaru. Italy's national recovery and resilience plan: Will it narrow the north-south productivity gap? *Italian Economic Journal: A Continuation of Rivista Italiana degli Economisti and Giornale degli Economisti*, 10(3):1281–1307, November 2024. doi: 10.1007/s40797-023-00254-2. URL https://ideas.repec.org/a/spr/italej/v10y2024i3d10.1007_s40797-023-00254-2.html.

Ministero dell'Economia e delle Finanze - Ragioneria Generale dello Stato. Circolare del 24 gennaio 2022, n. 4, "piano nazionale di ripresa e resilienza (pnrr) – rendicontazione milestone e target (m&t) connessi alla richiesta di pagamento alla ce del 30 giugno 2022 – sistema di gestione e controllo del pnrr". Circolare 4, Ministero dell'Economia e delle Finanze, 2022.

D. Moreira and S. Pérez. Civil service exams and organizational performance: Evidence from the pendleton act. *American Economic Journal: Applied Economics*, 16(3):250–91, July 2024. doi: 10.1257/app.20220284. URL https://www.aeaweb.org/articles?id=10.1257/app.20220284.

J. M. Robins, M. Á. Hernan, and B. Brumback. Marginal structural models and causal inference in epidemiology. *Epidemiology*, 11(5):550–560, 2000.

G. Spagnolo. Corruption and procurement. In S. Rose-Ackerman and T. Søreide, editors,

The International Handbook on the Economics of Corruption, Volume 2, pages 249–278. Edward Elgar Publishing, 2012.

E. A. Stuart. Matching methods for causal inference: A review and a look forward. *Statistical Science*, 25(1):1–21, 2010.

M. Weber. *Economy and society: An outline of interpretive sociology*, volume 2. University of California press, 1978.

J. Q. Wilson. *Bureaucracy: What government agencies do and why they do it*. Basic Books, 2019.

M. Ángel Almazán-Gómez, C. Llano, J. Pérez, D. Kallioras, and M. Tsiapa. Regional economic impact of the next generation european union recovery plan. *Papers in Regional Science*, 104 (4):100105, 2025. ISSN 1056-8190. doi: https://doi.org/10.1016/j.pirs.2025.100105. URL https://www.sciencedirect.com/science/article/pii/S1056819025000272.

A Plan Structure: Missions and Components

The Italian NRRP is a complex plan of reforms and investments, structured into 6 "Missions" (M), which are further divided into a total of 16 "Components" (C). The Missions represent the thematic and strategic areas of intervention:

- **M1: Digitalization, Innovation, Competitiveness, Culture and Tourism**
  - C1: Digitalization, innovation and security in the Public Administration
  - C2: Digitalization, innovation and competitiveness in the productive system
  - C3: Tourism and Culture 4.0
- **M2: Green Revolution and Ecological Transition**
  - C1: Circular economy and sustainable agriculture
  - C2: Renewable energy, hydrogen, grid and sustainable mobility
  - C3: Energy efficiency and building requalification
  - C4: Protection of the territory and water resources
- **M3: Infrastructure for Sustainable Mobility**
  - C1: Investments in the railway network
  - C2: Intermodality and integrated logistics
- **M4: Education and Research**
  - C1: Strengthening the provision of education services
  - C2: From research to business
- **M5: Inclusion and Cohesion**
  - C1: Labor policies
  - C2: Social infrastructure, families, communities and the third sector
  - C3: Special interventions for territorial cohesion (includes, e.g., Urban Integrated Plans and urban regeneration)
- **M6: Health**
  - C1: Proximity networks, facilities and telemedicine for territorial health assistance

  - C2: Innovation, research and digitalization of the national health service

- **M7: REPowerEU Chapter**[14]
  - C1: Strengthening and digitalization of energy grids
  - C2: Energy efficiency and support for renewables in buildings
  - C3: Development of national renewable energy supply chains
  - C4: Promotion of biomethane and green hydrogen
  - C5: Development of green skills and human capital

[14]While the NRRP officially retains 6 missions, the 2023 revision added this comprehensive new chapter for the REPowerEU plan. It is often referred to as the "seventh mission" due to its scale and strategic importance, focusing on ending dependency on Russian fossil fuels and accelerating the energy transition.

B Methodological details

A Propensity Score Reweighting

Propensity Score Estimation The propensity score is defined as the conditional probability of receiving NRRP funding given pre-treatment contract characteristics:

$$e(X_c) = P(\text{NRRP}_c = 1 | X_c) \tag{4}$$

where X_c includes contract value (`importo_lotto`), procurement sector (2-digit CPV code), and contract implementation modality. These covariates are selected because they:

1. Are determined *before* NRRP assignment
2. Predict both NRRP funding probability and procurement outcomes
3. Capture key structural differences between NRRP and non-NRRP contracts

We estimate the propensity score using logistic regression on contracts published from 2020 onwards (when NRRP became available), restricting the estimation sample to observations with complete covariate information. Rare categories (those with fewer than 30 observations or with zero observations in either treatment or control group) are pooled to ensure model stability.

ATT Weight Construction For each observation, we construct ATT weights as follows:

$$w_c^{ATT} = \begin{cases} 1 & \text{if NRRP}_c = 1 \\ \frac{e(X_c)}{1-e(X_c)} & \text{if NRRP}_c = 0 \end{cases} \tag{5}$$

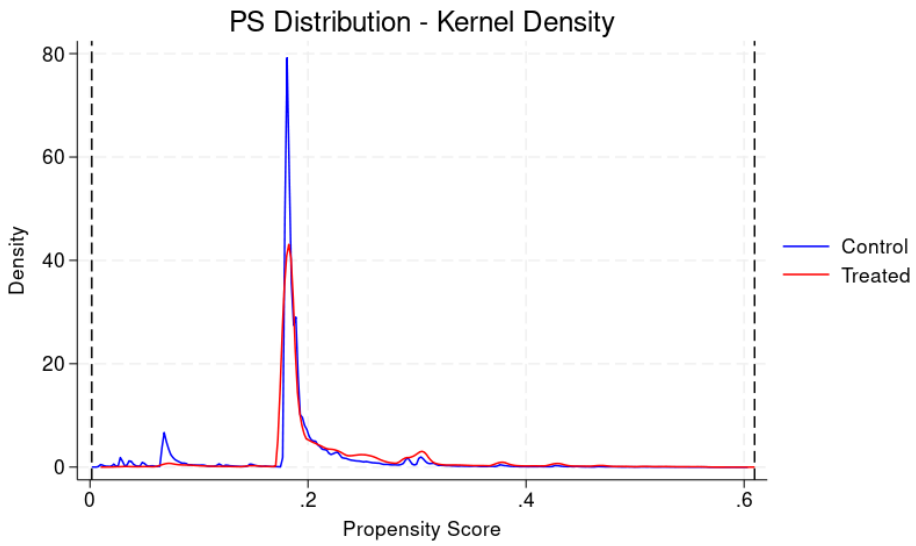
This weighting scheme assigns weight 1 to all treated units and reweights control units to resemble the treated group's covariate distribution. To improve stability and efficiency, we use *stabilized* ATT weights:

$$w_c^{ATT,stab} = \begin{cases} 1 & \text{if NRRP}_c = 1 \\ \frac{P(\text{NRRP}=1)}{1-P(\text{NRRP}=1)} \times \frac{e(X_c)}{1-e(X_c)} & \text{if NRRP}_c = 0 \end{cases} \tag{6}$$

where $P(\text{NRRP} = 1)$ is the marginal probability of treatment in the estimation sample. Stabilization reduces weight variability while preserving the ATT estimand (Robins et al., 2000). This rescaling does not change the ATT estimand—since it affects all control weights

Table B.1: Variable definitions

Variable	Definition
Outcome variables	
`awarded`	Dummy variable equal to 1 if contract was awarded (has awarding date), 0 otherwise
`Started / awarded`	Dummy variable equal to 1 if contract was awarded (has awarding date) or worksite has started, 0 otherwise
`awarding_time`	Number of days from contract publication to award decision
`Started`	Dummy variable equal to 1 if the execution phase has started, defined as the opening of at least one worksite associated with the contract (based on construction site records), 0 otherwise
`SAL`	Share of planned construction work completed at the observation date, measured using work progress reports (Stato Avanzamento Lavori, SAL), ranging from 0 to 1
`Advanced`	Dummy variable equal to 1 if the project has reached at least 50% of completion (SAL $\geq$ 0.50), 0 otherwise
`Nearly closed`	Dummy variable equal to 1 if the project has reached at least 65% of completion (SAL $\geq$ 0.65), 0 otherwise
`Almost closed`	Dummy variable equal to 1 if the project has reached at least 75% of completion (SAL $\geq$ 0.75), 0 otherwise
`Closed`	Dummy variable equal to 1 if the project is fully completed (SAL = 1), 0 otherwise
Treatment variables	
`NPRR_ct_plus` (γ)	Contract-level treatment (active): dummy equal to 1 if contract c was funded by NRRP and remained funded (captures deregulation + secure financing effects)
`NPRR_ct_minus` (δ)	Contract-level treatment (defunded): dummy equal to 1 if contract c was initially funded by NRRP but defunded in March 2024 revision (captures deregulation-only effect)
Contract characteristics	
`importo_lotto`	Contract value in euros
`time_at_risk`	Days from contract publication to observation date (31/12/2025)
`n_lotti`	Number of lots in the tender
Awarding procedure type (`tipo_agg`)	
Competitive	Open procedures, restricted procedures, competitive dialogue (maximum competition)
Negotiated	Negotiated procedures with or without call, simplified procedures (limited competition)
Direct	Direct awards, single-source contracts (no competition)
Other	Reserved contracts, in-house awards, innovation partnerships, special procedures
Contract implementation modality (`modalita_aggregata`)	
Standard procurement	Standard public procurement contract (*contratto d'appalto*)
Framework agreement	Framework agreement or descendant contract from framework
Convention	Contracts executed through administrative conventions
Concession	Service or work concession contracts
PPP/Project finance	Public-private partnerships and project financing arrangements
In-house management	Direct management by public administration (*in economia*)
General contractor	General contractor arrangements (*contraente generale*)
Other	Other special arrangements (co-design, subsidiarity, public competitions)
CPV classification (`cod_cpv_2`)	
Common Procurement Vocabulary 2-digit sector code classifying the object of procurement. Main categories include: Construction work (45), Maintenance services (50), Transport equipment (34), Energy products (09), Electrical machinery (31), and various other goods and services sectors.	
SOA category (`main_cate`)	
SOA categories identify the type of construction work required by the contract according to the Italian public procurement qualification system. They certify firms' technical and economic eligibility to execute specific categories of public works. Categories are divided into *general works* (OG, e.g. OG1 buildings, OG3 roads, OG2 restoration of protected buildings) and *specialized works* (OS, e.g. OS30 electrical systems, OS24 landscaping). SOA categories are used as controls to account for differences in technical complexity and specialization across contracts.	
.	



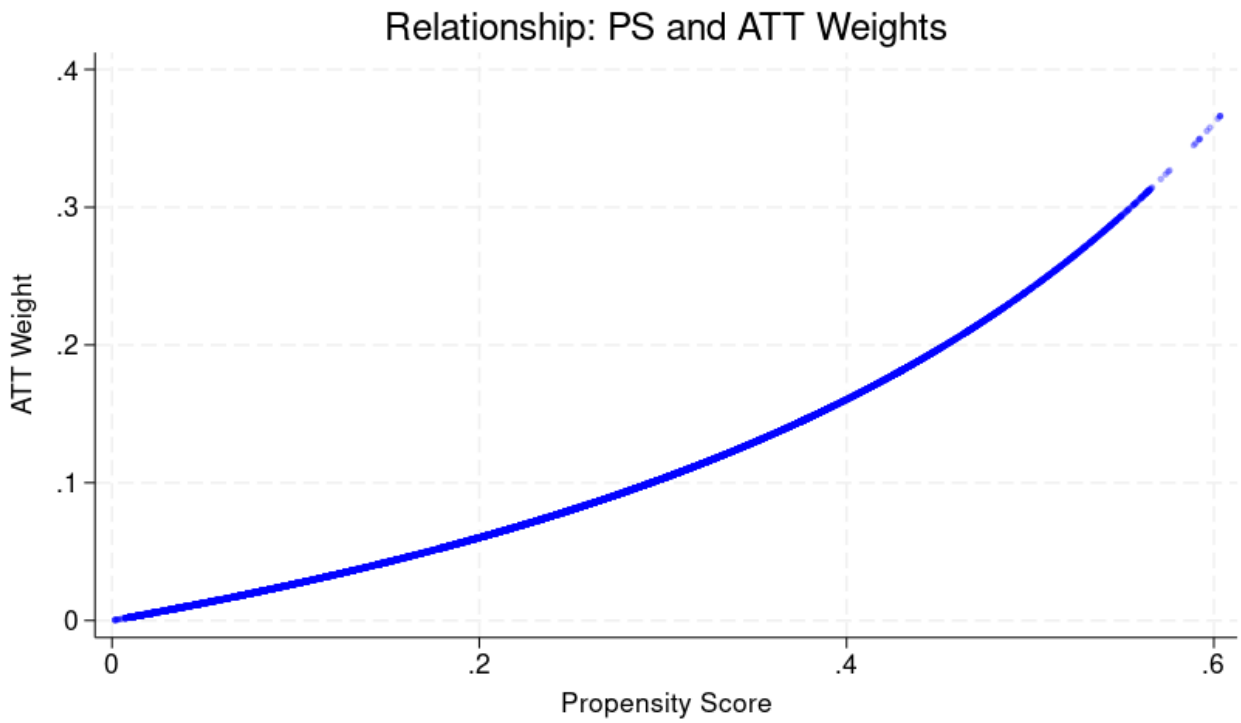
h!

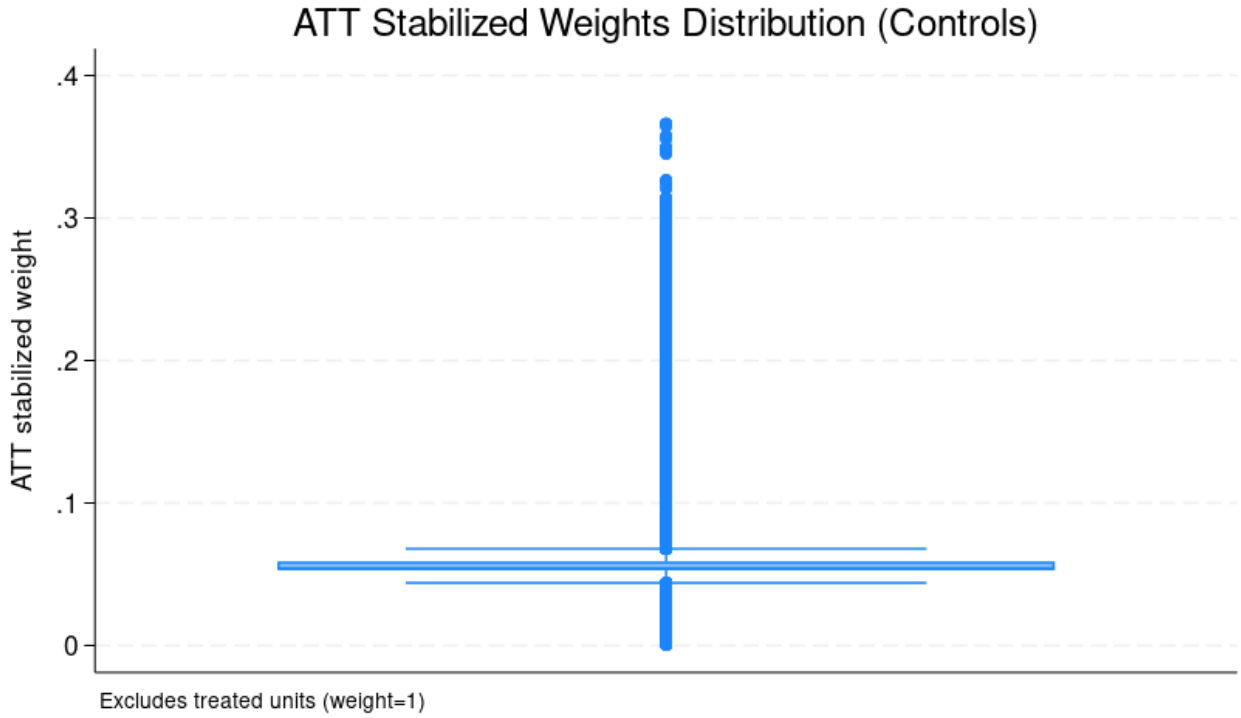
by the same constant factor, but improves the finite-sample behavior of our weighted fixed-effects regressions by preventing the very large pool of non-NRRP contracts from dominating the fit. Results are very similar when using non-stabilized ATT weights (see Appendix).

Common Support To ensure positivity (i.e., that both treated and control units exist across the covariate space), we impose a common support restriction based on the minimum and maximum propensity scores observed in each group within the estimation sample. Observations falling outside the common support region are excluded from the analysis. In our sample, this restriction removes approximately 0.01% of observations.

Propensity score distributions for treated and controls exhibit substantial overlap. Vertical dashed lines mark the common support bounds; only $\approx 0.01\%$ of observations fall outside and are excluded, supporting the positivity assumption.

Among controls, ATT (stabilized) weights increase monotonically with $e(X)$, confirming correct construction. The weight distribution shows limited dispersion (mass around the median), consistent with a high ESS and limited reliance on a small set of heavily weighted controls.


Relationship: PS and ATT Weights
ATT Weight
0
.1
.2
.3
.4
0
.2
.4
.6
Propensity Score


ATT Stabilized Weights Distribution (Controls)
ATT stabilized weight
0
.1
.2
.3
.4
Excludes treated units (weight=1)

B Additional tables

Table B.1: Main Results vs. Non-Stabilized ATT Weights

	Main (Stabilized)		**Non-Stabilized**	
Outcome	δ	λ	δ	λ
Award Stage				
Awarded	0.19***	0.19***	0.19***	0.20***
	(0.01)	(0.00)	(0.01)	(0.00)
Awarded or Started	0.12***	0.13***	0.11***	0.13***
	(0.01)	(0.00)	(0.01)	(0.00)
Awarding time (days)	-10.22***	-10.23***	-12.27***	-9.18***
	(1.52)	(0.70)	(1.38)	(0.62)
Implementation Stage				
Started	0.07***	-0.01	0.07***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)
SAL all	0.03**	-0.02***	0.02*	-0.03***
	(0.01)	(0.00)	(0.01)	(0.00)
Closed (SAL $\geq$ 0.25)	0.05***	-0.01**	0.05***	-0.01**
	(0.01)	(0.00)	(0.01)	(0.00)
Closed (SAL $\geq$ 0.50)	0.03**	-0.02***	0.02**	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)
Almost closed	0.01	-0.02***	-0.01	-0.03***
	(0.01)	(0.00)	(0.01)	(0.00)

Notes: "Main" reports ATT estimates using stabilized weights. "Non-stabilized" reports ATT estimates using non-stabilized weights. Standard errors clustered at the municipality level in parentheses. All specifications include municipality×year fixed effects and contract-level controls. δ = active NRRP contracts (never defunded); NRRP$^-$ = defunded contracts. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.2: Spillover Effects: Learning from NRRP Exposure (Different Weights)

Outcome	dose × Post-2021 (b)	dose × Post-2021 (se)
Awarded	0.0198**	(0.0081)
Sawarded	0.0224***	(0.0077)
AwardTime	1.1960	(1.2388)

Dependent variable: municipality-period fixed effects from first-stage regressions.
Coefficient: `dose_pre` × Post-2021, where Post = 1 if year $\geq$ 2021.
Weights: alternative weighting scheme (different from baseline).
Controls: Municipality and period FE absorbed. SE clustered at municipality level.
Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.3: Baseline vs. Alternative Weighting Scheme

	Baseline (Stabilized)		**Different Weights**	
Outcome	b	(se)	b	(se)
Awarded	0.03***	(0.01)	0.02**	(0.01)
Awarded/started	0.03***	(0.01)	0.02***	(0.01)
Awarding time (days)	1.25	(1.32)	1.20	(1.24)

Notes: Coefficients report the financing effect ($\gamma - \delta$). Baseline uses stabilized ATT weights; "Different Weights" uses non-stabilized weights. Standard errors clustered at the municipality level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

C Additional graphs

Table B.4: Main Results: Dose Defined on Value vs. Dose Defined on N

	Baseline (Value)		**Dose Defined on N**	
Outcome	δ	λ	δ	λ
Panel A: Award Stage				
Awarded	0.19***	0.19***	0.19***	0.19***
	(0.01)	(0.00)	(0.01)	(0.00)
Awarded or Started	0.12***	0.13***	0.12***	0.13***
	(0.01)	(0.00)	(0.01)	(0.00)
Awarding time (days)	-10.22***	-10.23***	-10.42***	-10.21***
	(1.52)	(0.70)	(1.52)	(0.71)
Panel B: Implementation Stage				
Started	0.07***	-0.01	0.07***	-0.01
	(0.01)	(0.00)	(0.01)	(0.00)
SAL all	0.03**	-0.02***	0.03***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)
Closed (SAL $\geq$ 0.25)	0.05***	-0.01**	0.05***	-0.01**
	(0.01)	(0.00)	(0.01)	(0.00)
Closed50 (ANCE threshold = 0.50)	0.03**	-0.02***	0.03***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)
Almost closed (SAL $\geq$ 0.75)	0.01	-0.02***	0.01	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)

Notes: ATT estimates from contract-level regressions with municipality×year fixed effects and contract-level controls. Standard errors clustered at the municipality level in parentheses. δ = active NRRP contracts (never defunded); NRRP^{-} = defunded contracts. Panel A: Baseline N = 192,756; Dose-on-N N = 193,237. Panel B: Baseline N = 192,756 (191,647 for SALS); Dose-on-N N = 193,237 (192,117 for SALS). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.5: Baseline vs. Alternative Dose Definition

	Baseline Dose		**Alternative Dose**	
Outcome	b	(se)	b	(se)
Awarded	0.03***	(0.01)	0.02***	(0.01)
Awarded/started	0.03***	(0.01)	0.02***	(0.01)
Awarding time (days)	1.25	(1.32)	0.90	(1.02)

Notes: Coefficients report the financing effect ($\gamma - \delta$). Standard errors clustered at the municipality level. Baseline dose corresponds to the main treatment definition; Alternative dose redefines treatment intensity based on the number of NRRP contracts. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.6: Baseline vs. Robustness Controlling for FOI

	Baseline		**+ FOI Control**	
Outcome	δ	λ	δ	λ
Panel A: Award Stage				
Awarded	0.19***	0.19***	0.19***	0.20***
	(0.01)	(0.00)	(0.01)	(0.00)
Awarded or Started	0.12***	0.13***	0.13***	0.13***
	(0.01)	(0.00)	(0.01)	(0.00)
Awarding time (days)	-10.22***	-10.23***	-11.48***	-10.64***
	(1.52)	(0.70)	(1.60)	(0.70)
Panel B: Implementation Stage				
Started	0.07***	-0.01	0.06***	-0.01**
	(0.01)	(0.00)	(0.01)	(0.00)
SAL_all	0.03**	-0.02***	0.02**	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)
Closed (SAL $\geq$ 0.25)	0.05***	-0.01**	0.04***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)
Closed (SAL $\geq$ 0.50)	0.03**	-0.02***	0.02**	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)
Almost closed (SAL $\geq$ 0.75)	0.01	-0.02***	0.00	-0.03***
	(0.01)	(0.00)	(0.01)	(0.00)

Notes: ATT estimates from contract-level regressions with municipality×year fixed effects and contract-level controls. The right-hand specification additionally controls for FOI exposure. Standard errors clustered at the municipality level in parentheses. δ = active NRRP contracts (never defunded); NRRP^{-} = defunded contracts. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.7: Baseline vs. Treating 2020 NRRP Contracts as Non-NRRP

	Baseline		**2020 Treated as Non-NRRP**	
Outcome	δ	λ	δ	λ
Panel A: Award Stage				
Awarded	0.19***	0.19***	0.20***	0.21***
	(0.01)	(0.00)	(0.01)	(0.01)
Awarded/started	0.12***	0.13***	0.12***	0.12***
	(0.01)	(0.00)	(0.01)	(0.00)
Awarding time (days)	-10.22***	-10.23***	-9.46***	-7.92***
	(1.52)	(0.70)	(1.54)	(0.71)
Panel B: Implementation Stage				
Started	0.07***	-0.01	0.06***	-0.03***
	(0.01)	(0.00)	(0.01)	(0.01)
SAL_all	0.03**	-0.02***	0.02**	-0.04***
	(0.01)	(0.00)	(0.01)	(0.01)
First progress (SAL $\geq$ 0.25)	0.05***	-0.01**	0.04***	-0.03***
	(0.01)	(0.00)	(0.01)	(0.01)
Closed50	0.03**	-0.02***	0.02**	-0.04***
	(0.01)	(0.00)	(0.01)	(0.01)
Almost closed	0.01	-0.02***	-0.00	-0.04***
	(0.01)	(0.00)	(0.01)	(0.01)

Notes: ATT estimates from contract-level regressions with municipality×year fixed effects and contract-level controls. The right-hand specification classifies 2020 NRRP contracts as non-NRRP. Standard errors clustered at the municipality level in parentheses. δ = active NRRP contracts (never defunded); NRRP^{-} = defunded contracts. Observations: 192,756 for all outcomes except awarding time (N = 140,653). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.8: Pre-Trends (Event Study Estimates) – Main Specification

	Awarded		Awarded/Started		Awarding time (days)	
Year	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
2016	0.047**	(0.022)	0.042*	(0.022)	1.387	(4.442)
2017	0.009	(0.018)	0.002	(0.017)	0.691	(2.696)
2018	0.027*	(0.016)	0.024	(0.016)	1.911	(2.726)
2019	0.013	(0.013)	0.008	(0.012)	-0.142	(2.134)
2020 (base)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
2021	0.027***	(0.010)	0.026***	(0.010)	1.170	(1.445)
2022	0.023**	(0.011)	0.028***	(0.010)	2.644	(1.648)
2023	0.046***	(0.012)	0.037***	(0.011)	-1.379	(2.029)

Notes: 2020 is the omitted (reference) year. Entries report event-time coefficients from the baseline specification with municipality×year fixed effects and contract-level controls. Standard errors clustered at the municipality level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.9: Pre-Trends by Administrative Capacity (MAQI Split)

	Awarded		Awarded/Started		Awarding time (days)	
Year	Low	High	Low	High	Low	High
2016	0.060	0.036	0.068*	0.022	-3.906	5.167
	(0.040)	(0.027)	(0.039)	(0.028)	(6.229)	(6.638)
2017	0.008	0.007	0.008	-0.003	-4.081	1.216
	(0.032)	(0.023)	(0.030)	(0.022)	(4.224)	(3.387)
2018	0.020	0.037*	0.018	0.032	-0.025	1.837
	(0.026)	(0.022)	(0.026)	(0.021)	(4.982)	(3.529)
2019	0.013	0.021	0.008	0.017	-0.394	0.999
	(0.021)	(0.016)	(0.020)	(0.016)	(3.696)	(2.625)
2020 (base)	0.000	0.000	0.000	0.000	0.000	0.000
2021	0.021	0.032**	0.015	0.036***	-0.181	2.187
	(0.015)	(0.014)	(0.014)	(0.014)	(2.413)	(1.833)
2022	0.022	0.029*	0.024	0.030**	0.734	4.534**
	(0.017)	(0.015)	(0.015)	(0.014)	(2.875)	(1.997)
2023	0.055***	0.028	0.041***	0.021	-1.312	-1.589
	(0.018)	(0.018)	(0.016)	(0.016)	(3.686)	(2.081)

Notes: Event-study coefficients from specification including municipality×year fixed effects and contract-level controls. Municipalities split by median ex-ante administrative capacity (MAQI). 2020 is the omitted reference year. Standard errors clustered at the municipality level in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.10: Pre-Trends by Administrative Capacity – Pillar 1

	Awarded		Awarded/Started		Awarding time (days)	
Year	Low	High	Low	High	Low	High
2016	0.072**	0.014	0.075**	0.003	-7.183	10.060
	(0.031)	(0.031)	(0.030)	(0.033)	(4.886)	(7.891)
2017	0.023	-0.013	0.009	-0.010	0.603	-3.318
	(0.027)	(0.025)	(0.026)	(0.025)	(4.179)	(3.266)
2018	0.016	0.035	0.008	0.036*	-3.280	4.558
	(0.026)	(0.022)	(0.026)	(0.021)	(4.494)	(3.765)
2019	0.004	0.022	0.007	0.010	-1.444	1.788
	(0.019)	(0.018)	(0.018)	(0.017)	(3.168)	(3.054)
2020 (base)	0.000	0.000	0.000	0.000	0.000	0.000
2021	0.021	0.033**	0.029**	0.023	0.655	1.329
	(0.015)	(0.015)	(0.014)	(0.014)	(2.163)	(2.030)
2022	0.018	0.033**	0.024*	0.035**	2.090	2.955
	(0.016)	(0.016)	(0.014)	(0.015)	(2.498)	(2.383)
2023	0.032*	0.056***	0.030*	0.040***	-1.684	-0.862
	(0.018)	(0.017)	(0.016)	(0.016)	(2.799)	(3.105)

Notes: Event-study coefficients from baseline specification for Pillar 1 contracts. Municipalities split by median ex-ante administrative capacity (MAQI). 2020 is the omitted reference year. Standard errors clustered at the municipality level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.11: Pre-Trends by Administrative Capacity – Pillar 2

	Awarded		Awarded/Started		Awarding time (days)	
Year	Low	High	Low	High	Low	High
2016	0.045	0.048	0.040	0.043	-1.500	4.999
	(0.033)	(0.032)	(0.034)	(0.032)	(5.448)	(7.500)
2017	0.003	0.012	-0.004	0.008	-1.881	-0.646
	(0.029)	(0.024)	(0.028)	(0.023)	(3.634)	(3.632)
2018	0.024	0.036	0.017	0.036	0.970	1.044
	(0.024)	(0.024)	(0.023)	(0.023)	(4.580)	(3.684)
2019	0.013	0.023	0.002	0.024	1.351	-0.387
	(0.020)	(0.017)	(0.019)	(0.017)	(3.599)	(2.664)
2020 (base)	0.000	0.000	0.000	0.000	0.000	0.000
2021	0.009	0.047***	0.001	0.052***	0.502	1.260
	(0.014)	(0.015)	(0.014)	(0.015)	(2.284)	(1.935)
2022	0.009	0.045***	0.005	0.054***	1.311	4.729**
	(0.016)	(0.016)	(0.014)	(0.015)	(2.557)	(2.386)
2023	0.039**	0.051***	0.024	0.045***	-2.164	-0.036
	(0.017)	(0.018)	(0.015)	(0.016)	(3.322)	(2.519)

Notes: Event-study coefficients from baseline specification for Pillar 2 contracts. Municipalities split by median ex-ante administrative capacity (MAQI Pillar 2). 2020 is the omitted reference year. Standard errors clustered at the municipality level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.12: Pre-Trends by Administrative Capacity – Pillar 3

	Awarded		Awarded/Started		Awarding time (days)	
Year	Low	High	Low	High	Low	High
2016	0.053	0.030	0.049	0.024	-5.957	7.565
	(0.038)	(0.028)	(0.038)	(0.029)	(6.178)	(6.709)
2017	0.019	-0.007	0.010	-0.014	-5.877	0.789
	(0.033)	(0.022)	(0.031)	(0.022)	(5.301)	(2.897)
2018	0.030	0.026	0.023	0.025	0.074	1.382
	(0.028)	(0.020)	(0.027)	(0.019)	(4.664)	(3.539)
2019	0.015	0.018	0.013	0.011	-1.267	0.849
	(0.019)	(0.017)	(0.019)	(0.016)	(3.467)	(2.768)
2020 (base)	0.000	0.000	0.000	0.000	0.000	0.000
2021	0.037**	0.015	0.035**	0.016	0.866	0.972
	(0.015)	(0.014)	(0.015)	(0.013)	(2.217)	(1.948)
2022	0.032*	0.016	0.041***	0.013	0.486	4.695**
	(0.016)	(0.015)	(0.015)	(0.014)	(2.666)	(2.132)
2023	0.062***	0.022	0.052***	0.013	-0.921	-0.639
	(0.018)	(0.017)	(0.016)	(0.015)	(3.457)	(2.125)

Notes: Event-study coefficients from baseline specification for Pillar 3 contracts. Municipalities split by median ex-ante administrative capacity (MAQI Pillar 3). 2020 is the omitted reference year. Standard errors clustered at the municipality level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.13: Orthogonality between exposure (Dose) and administrative capacity (MAQI)

	(1) Unconditional	**(2) Conditional (FWL)**
Panel A: Correlation		
$\rho(\text{Dose}, \text{MAQI})$	−0.0970	−0.0058
Panel B: Regression slope		
$\hat{\beta}$	−0.1127	−0.0067
SE($\hat{\beta}$)	0.0145	0.0146
p-value	0.0000	0.6481
R^2	0.0094	0.0000

Notes. Column (1) reports the raw association between municipal exposure to NRRP (Dose) and administrative capacity (MAQI) in the pre-NRRP period. Column (2) reports the *partial* association after conditioning on baseline (pre-NRRP): we regress Dose on X_{pre} and keep residuals $\text{Dose}^{\perp X}$; we regress MAQI on the same X_{pre} and keep residuals $\text{MAQI}^{\perp X}$; finally we estimate $\text{Dose}^{\perp X}$ on $\text{MAQI}^{\perp X}$ on the identical common sample. Baseline controls X_{pre} (aggregated at the municipality level over year < 2020) include: mean lot value, number of contracts, shares of awarding procedures , shares of procurement modalities , CPV composition , average number of lots, and average time-at-risk .

Table B.14: Robustness to Alternative Definitions of Ex-Ante Administrative Capacity (MAQI)

	Pre (2018–19)		2018		2019		2016–2019	
	Low	High	Low	High	Low	High	Low	High
Active NRRP (γ)								
Award stage								
Awarded	0.23***	0.18***	0.23***	0.18***	0.23***	0.18***	0.22***	0.18***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Awarded/started	0.14***	0.11***	0.15***	0.11***	0.14***	0.11***	0.14***	0.11***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Awarding time (days)	-9.74***	-10.50***	-9.64***	-10.39***	-7.90**	-10.79***	-8.56***	-10.59***
	(3.21)	(1.80)	(2.80)	(1.84)	(3.25)	(1.80)	(3.02)	(1.81)
Implementation stage								
Started	0.07***	0.07***	0.08***	0.07***	0.07***	0.07***	0.08***	0.07***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
SAL_all	0.02	0.03***	0.04**	0.03***	0.02	0.03***	0.04**	0.03***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Closed25	0.05**	0.05***	0.06***	0.05***	0.05**	0.05***	0.07***	0.05***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Closed50	0.03	0.04***	0.05**	0.03**	0.02	0.04***	0.05**	0.03***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Almost closed	0.01	0.01	0.02	0.01	-0.00	0.01	0.02	0.01
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Defunded NRRP (δ)								
Awarded	0.23***	0.18***	0.21***	0.19***	0.23***	0.18***	0.22***	0.19***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Awarded/started	0.15***	0.12***	0.14***	0.13***	0.15***	0.12***	0.14***	0.12***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Awarding time	-8.27***	-10.94***	-8.44***	-11.10***	-8.32***	-10.84***	-8.88***	-10.76***
	(1.30)	(0.92)	(1.31)	(0.92)	(1.28)	(0.93)	(1.26)	(0.93)
Started	-0.01	-0.00	-0.01	-0.00	-0.00	-0.00	-0.01*	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
SAL_all	-0.02***	-0.01**	-0.02**	-0.01**	-0.02*	-0.02**	-0.02***	-0.01*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Closed25	-0.01*	-0.01	-0.01*	-0.01	-0.01	-0.01	-0.02**	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Closed50	-0.02**	-0.01*	-0.02**	-0.01*	-0.01	-0.02**	-0.02**	-0.01*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Almost closed	-0.03***	-0.02***	-0.03***	-0.02***	-0.02***	-0.02***	-0.03***	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

Notes: Columns report low- and high-capacity municipalities under alternative MAQI definitions. All specifications include municipality×year fixed effects and contract controls. Standard errors clustered at the municipality level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.15: NPRR Effects by Municipality Size (Median Split)

	Small municipalities		**Large municipalities**	
Outcome	$NPRR^{+}$	$NPRR^{-}$	$NPRR^{+}$	$NPRR^{-}$
Panel A: Award stage				
awarded	0.20***	0.20***	0.18***	0.18***
	(0.01)	(0.01)	(0.01)	(0.01)
sawarded	0.13***	0.13***	0.11***	0.13***
	(0.01)	(0.01)	(0.01)	(0.01)
awarding_time	-8.55***	-6.63***	-11.55***	-13.41***
	(2.34)	(0.91)	(1.94)	(1.04)
Panel B: Implementation stage				
started	0.06***	-0.01	0.08***	-0.00
	(0.02)	(0.01)	(0.01)	(0.01)
SAL_all	0.02	-0.02***	0.04***	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)
Closed (SAL $\geq$ 0.25)	0.04**	-0.01**	0.06***	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)
closed50	0.02	-0.02***	0.04***	-0.01*
	(0.02)	(0.01)	(0.01)	(0.01)
almost_closed	0.01	-0.03***	0.01	-0.01*
	(0.02)	(0.01)	(0.01)	(0.01)

Notes: Coefficients reported with standard errors in parentheses. Split based on the median municipality population (7,568 inhabitants). Controls: amount, procedure, modality, CPV, category, time at risk. Fixed effects: Municipality × Year. Weights: stabilized ATT. Standard errors clustered at the municipality level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.16: Spillover Effects by Municipality Size

Outcome	Small municipalities	Large municipalities
Awarded	0.026***	0.034*
	(0.009)	(0.018)
Awarded/started	0.023**	0.029*
	(0.009)	(0.016)
Awarding time (days)	-0.941	5.067*
	(1.429)	(2.885)

Notes: Difference-in-Differences learning coefficient from *dose* × *Post-2021* (Post = 1 if year $\geq$ 2021). Municipality and period fixed effects included. Standard errors clustered at the municipality level. Municipalities split at the median population (7,568). Positive coefficients indicate increasing spillover effects over time. Observations: N = 9,100 (small) and N = 3,146 (large) for all outcomes except *awarding time* (N = 6,860 small; N = 2,986 large). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Figure C.1: Pre-trends: Main Specification

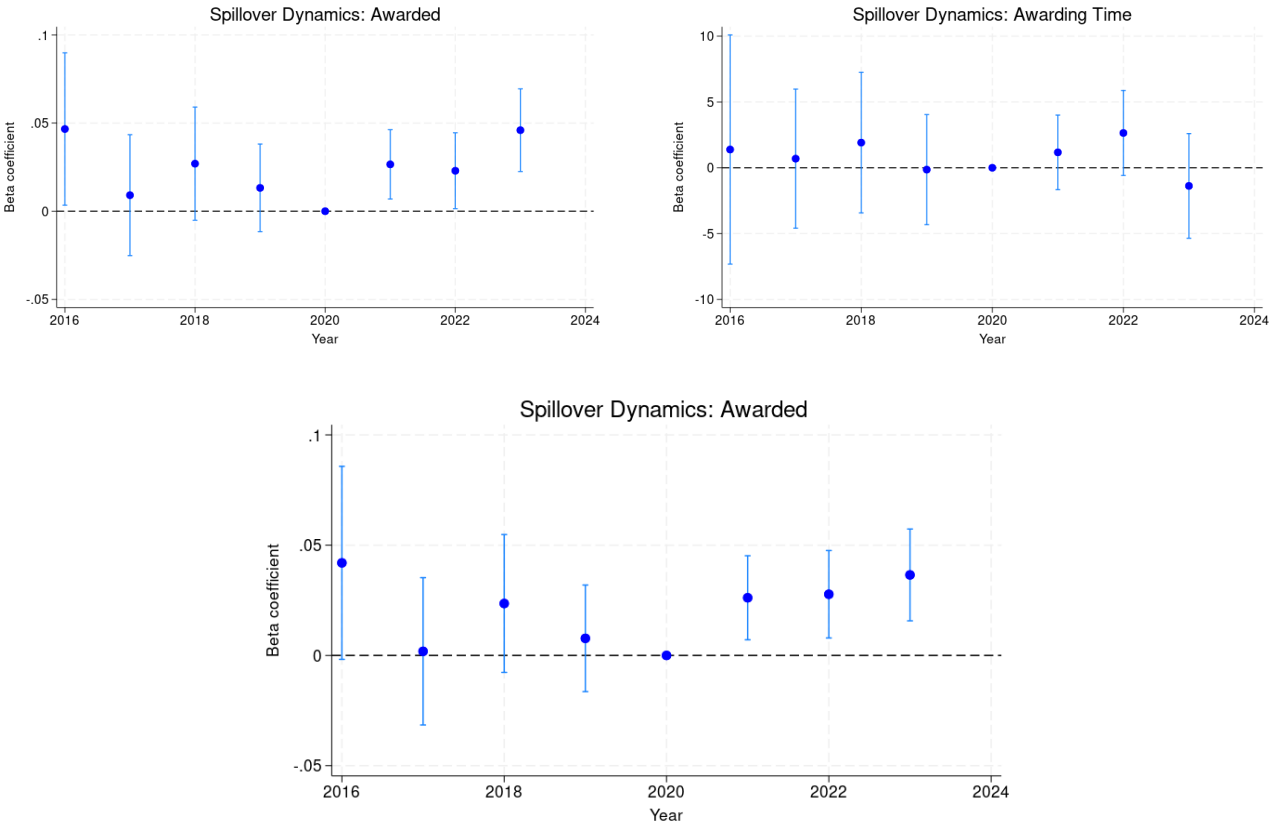


Figure C.2: Pre-trends by Administrative Capacity (MAQI)

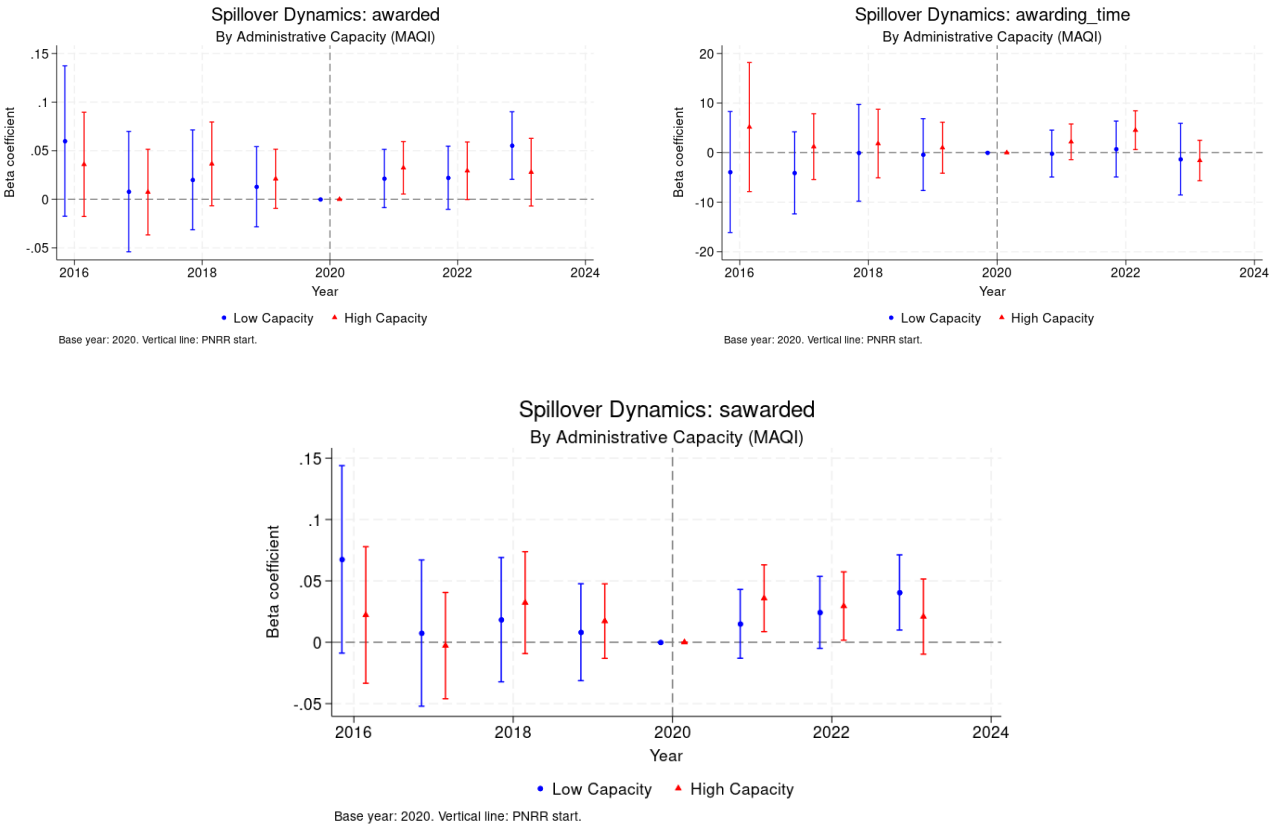


Figure C.3: Pre-trends: Pillar 1 – Bureaucratic Efficiency

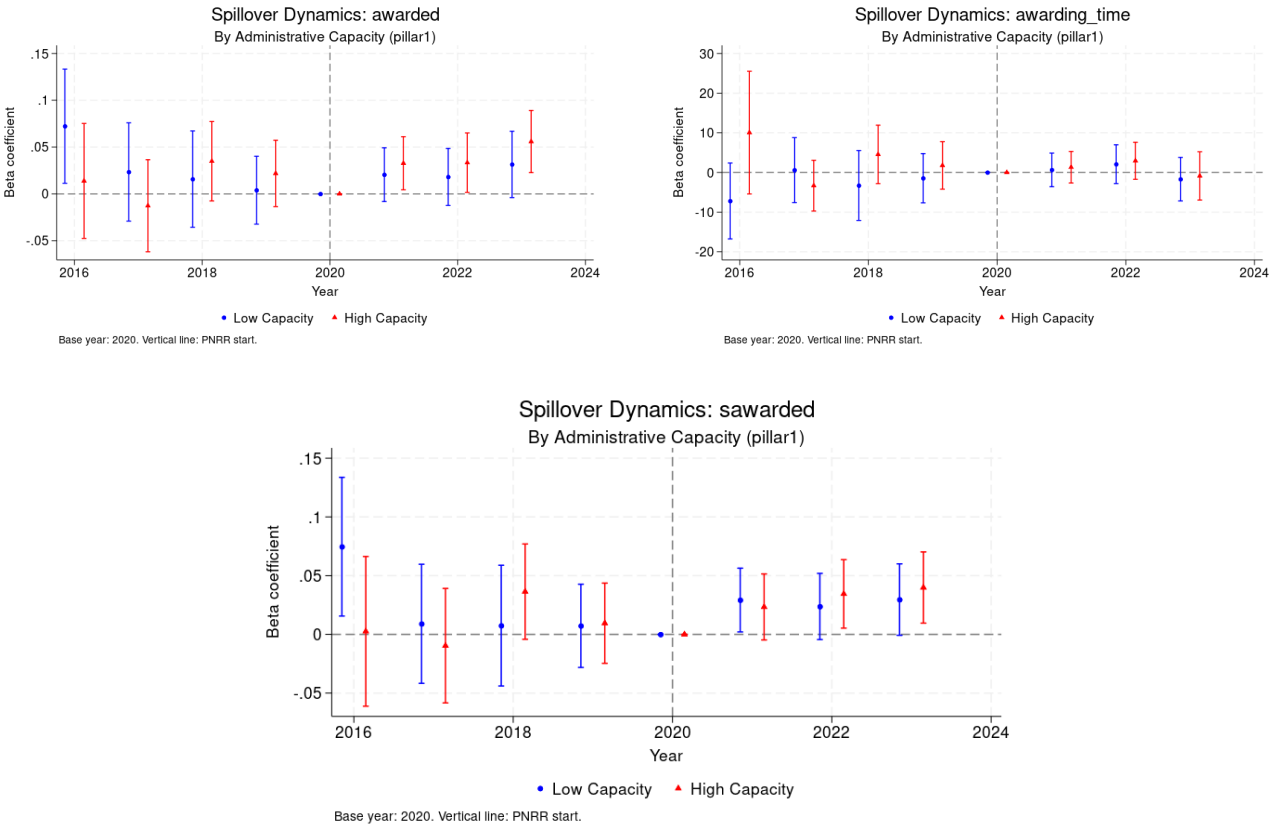


Figure C.4: Pre-trends: Pillar 2 – Political Leadership

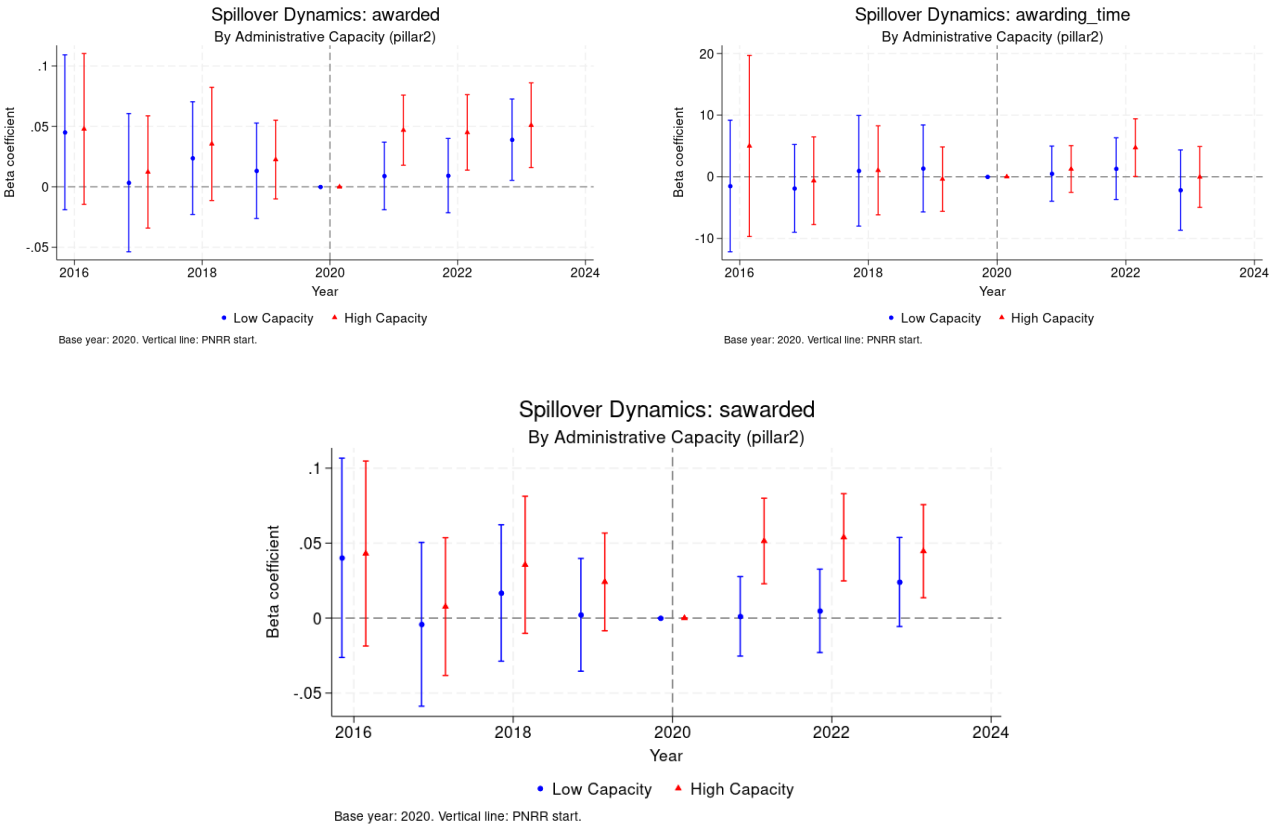


Figure C.5: Pre-trends: Pillar 3 – Fiscal and Economic Performance

