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"*Public budget and collective choices*"

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General introduction

Public action in democratic contexts is commonly understood as the expression of collective preferences. In practice, the principal instrument through which democracies implement such action is the allocation of public resources: financial support is directed toward objectives that achieve broad legitimacy, translating societal priorities into actionable policies. Across the economic and social science literature, scholars have long sought to understand how collective action – undertaken across different levels of governance and institutional settings – shapes economic outcomes. Particular attention has been devoted to the mechanisms through which governments allocate resources via the fiscal process and how these choices interact with inclusiveness, transparency, and accountability.

In his seminal work *The Theory of Public Finance* (1959), Richard Musgrave identifies allocation, distribution, and stabilization as the core functions of public finance. Beyond their technical character, these functions provide a forum in which enduring social tensions are negotiated through democratic bargaining. As Musgrave later observes, the fiscal process "provides the forum on which interest groups and ideologies may clash without resort to the barricades and on which compromise and cooperation may be sought" (Musgrave, 1981, p. 76). Budgets, therefore, are not merely exercises in arithmetic, but institutional arenas in which collective choices are realized amid persistent conflicts over priorities and resources.

While Musgrave describes the normative functions of fiscal policy, the actual realization of these functions depends on the institutional and administrative environment in which policy is implemented. Douglass North (1990), building on Coase's insights on transaction costs (Coase, 1937; 1960), defines institutions as the humanly devised constraints that structure interactions, reduce uncertainty, and guide behaviour over time, in short "*the rules of the game*". From this perspective, fiscal rules and budgets are embedded in a web of formal procedures, governance arrangements, and behavioural norms that condition how resources are allocated in practice. Understanding public action therefore requires not only a functional perspective, but also an institutional one: formal prerogatives are necessary but not sufficient for predictable policy outcomes.

These formal prerogatives are embedded in systems of checks and balances, particularly through the legislature's "power of the purse", which grants parliaments ultimate authority over revenue and expenditure authorisation (Wehner, 2006). The budgeting process typically

unfolds in five stages – preparation, approval, execution, accounting, and audit – structured to ensure accountability between executive and legislative branches in normal times (OECD 2004). Nonetheless, while providing rigor in “normal times” this structured equilibrium could be vulnerable in case of socio-economic disruptions.

Crises provide a particularly revealing context in which to examine these dynamics, as emergencies – whether natural disasters, economic shocks, or other disruptive events – challenge institutional equilibria, bypassing or compressing the standard budgeting stages, altering priorities, and exposing decision-making to new pressures. Extensive interdisciplinary literature has dealt with the implications of emergencies, with particular attention to the concept of polycrisis—a condition where multiple global emergencies (environmental, economic, and geopolitical) are inextricably entangled, such that the whole is more dangerous than the sum of its parts.

This strand of literature focuses on how such shocks impact social structures and constitutionalism, understood as the legal and political framework that limits governmental power through the rule of law and the protection of fundamental rights. Scholars emphasize the tension between stability and urgency; for instance, in the aftermath of a crisis, “emergency is the Constitution’s worst enemy” (Palermo, 2026, p. 215). This is because when public safety is seriously threatened, there may be a perceived need for "quick and decisive action that cannot, perhaps, wait for the deliberate pace of ordinary constitutional rule” (Ferejohn and Pasquino, 2004, p. 210). In fact, when a polycrisis occurs, it can lead to a systemic dysfunctionality that undermines the very "pillars of constitutional imaginaries of Western and particularly of European constitutionalism” (Belov, 2023, p. 3).

Furthermore, from a public budget perspective, these theoretical tensions manifest as concrete fiscal constraints. Supranational structures that share common policy objectives, such as the European Union, overlay additional constraints on national budgets via fiscal rules (e.g., under the Stability and Growth Pact), with recent reforms like the 2024 net primary expenditure paths further tightening coordination (Ufficio Parlamentare di Bilancio, 2024). Thus, in extraordinary times, these prerogatives face direct pressure: parliamentary oversight may yield to executive decrees, fiscal rules suspended via escape clauses, and tensions arise between democratic budgeting and supranational imperatives, as seen in recent fiscal consolidation efforts (Di Majo, 2020).

Therefore, linking Musgrave's functional framework with an institutional perspective allows us to analyse how crises reveal the interplay between formal fiscal prerogatives, governance structures, and the behaviour of public actors, shaping the allocation of resources in ways that standard models of public finance may not fully anticipate.

This thesis adopts this perspective, emphasising that public budgets, while normatively designed to perform allocation functions efficiently, operate within complex institutional environments that can react differently under exogenous pressure brought about by emergencies. Understanding how crises interact with governance and administrative capacity is essential not only for explaining variation in policy implementation, but also for drawing broader insights into the functioning of democratic governance and the realization of collective choices in practice.

1 Public budgets in emergency contexts

1.1 Introduction

Public organisations increasingly operate under conditions of turbulence, characterised by crises, urgency, shifting priorities, and compressed timelines. Recent years have illustrated the frequency and intensity of such disruptions, from the COVID-19 pandemic to the Russian invasion of Ukraine, recurrent climate-related disasters such as wildfires and floods, and humanitarian crises including the genocide in Palestine (United Nations, 2025, A/80/492). Such events, and the very definition of these crises[1], create politically sensitive and potentially divisive contexts, in which governments must make rapid decisions about allocating public resources. Polycrisies place extraordinary demands on governments, requiring them to manage resources while maintaining legitimacy, transparency, and accountability. Crises thus provide a unique lens to observe how fiscal processes and institutional arrangements interact to shape public action in practice.

Periods of emergency often necessitate extraordinary policy responses, disrupting patterns of social, organizational, and political interaction and altering how governments rule (‘t Hart, Rosenthal, and Kouzmin, 1993; Ansell et al., 2010). A prominent feature of many such interventions is the reliance on extra-budgetary funds (EBFs), which operate outside standard budgetary procedures and follow their own priorities, control mechanisms, and allocation rules (Allen and Radev, 2006). During the COVID-19 pandemic, for example, governments worldwide implemented diverse measures – including tax reductions, direct spending, loans, guarantees, and monetary interventions – to stabilise economies and sustain households and firms (IMF, 2020). At the supranational level, the European Union (EU) launched initiatives such as the activation of the general escape clause of the Stability and Growth Pact, temporary State-aid frameworks, the SURE programme for short-time work schemes, and Next

[1] As a matter of fact, the very definition of crises can be socially disruptive. For example, the climate crisis is scientifically supported, but across the globe many people do not believe in it, including the President of the United States of America Donald Trump. On the same note, the support for Ukraine against the Russian invasion is not unanimously supported across Europe. Similarly, the humanitarian crisis in Palestine has drawn particular attention due to its complex and contested dynamics. Political unrest and social uprisings have been common across Europe since October 7th, 2023 – the date of the Hamas attack – and throughout the following two years. European governments responded in diverging ways to these protests, reflecting deep internal political cleavages. The situation was further complicated as UN bodies and special rapporteurs investigated the conflict, with reports (e.g., United Nations, 2025, A/80/492) addressing the classification of the military response under the framework of the Genocide Convention. This terminological and political dispute exemplifies how the "definition" of a crisis is itself a source of institutional turbulence.

Generation EU (NGEU), implemented through National Recovery and Resilience Plans (NRRPs). The NGEU governance framework, totalling €806.9 billion (2021 prices), introduced a distinctive set of crisis-time checks and balances: funds are disbursed in tranches conditional on the achievement of milestones and targets verified by the European Commission, alongside reporting requirements to national parliaments and the European Parliament. This design aims to reconcile the need for rapid executive action with mechanisms of democratic accountability under conditions of urgency. This response marked a significant departure from earlier crisis-management approaches. In the aftermath of the 2008 global financial crisis and the subsequent sovereign debt crisis, EU intervention relied largely on monetary policy – most notably through the European Central Bank's quantitative easing – while fiscal rules remained largely binding and direct fiscal intervention at the European level was limited. By contrast, the COVID-19 crisis prompted a relaxation of fiscal constraints and the introduction of large-scale, centrally coordinated fiscal instruments. This represented a stark change from previous crisis responses, that might have been fundamentally shaped by the institutional environment in which governments operated.

While these mechanisms allowed resources to be mobilised quickly, they also raised critical questions about governance. Accountability and oversight may be weakened when procedures are bypassed or adapted in *ad hoc* ways (Heald and Hodges, 2020), while the centralisation of emergency budgeting can limit parliamentary scrutiny and broad participation. Moreover, the legitimacy and societal acceptance of such interventions depend on perceptions of fairness and transparency in allocation decisions (Farazmand et al., 2025). Crises thus reveal how institutional settings – rather than fiscal arrangements alone – shape government behaviour, exposing tensions between the formal fiscal prerogatives envisaged by normative frameworks, such as Musgrave's allocation function, and the practical operation of public budgets under emergency-induced institutional change. In addition to emergency funding mechanisms, the effective allocation of resources depends on governance structures and administrative capacities. Drawing on North's institutional perspective (1990), institutions are understood as the formal and informal rules that structure interactions, reduce uncertainty, and guide behaviour. In crisis contexts, these rules and capacities condition the speed, reach, and equity of public spending. For example, the capacity to absorb and deploy funds, the choice of different implementation frameworks, and the discretion exercised by contracting authorities in public procurement all shape how allocation functions are realised in practice. By examining

these institutional and behavioural dimensions, it is possible to understand how crises expose trade-offs, bottlenecks, and frictions that may remain hidden in normal times.

Despite the practical importance of these dynamics, relatively little research in economics has examined how fiscal allocation interacts with institutional arrangements and administrative behaviour specifically under conditions of emergency. While some strands of literature have provided substantial insights into territorial allocation, local capacity, and funding absorption, much of this work focuses on stable contexts or formal rules, leaving less understanding of how crises can fundamentally reshape governance structures, decision-making processes, and the realised allocation of public resources. Emergencies may alter institutional and fiscal arrangements, for instance by modifying regulatory procedures, introducing extraordinary funding mechanisms, or concentrating authority in centralised bodies, thereby exposing trade-offs and frictions that are less visible in normal times. This thesis addresses this gap by empirically examining how emergencies influence public spending decisions and governance processes at the local and regional level. Its contribution is primarily empirical – documenting variation in allocation under emergency conditions – while providing a conceptual interpretation that links observed patterns to institutional constraints and fiscal principles.

The analysis concentrates on Italy, which offers a particularly compelling case study due to its long-standing political and economic instability and its recurrent exposure to natural and socio-economic shocks. Existing work shows that public budgets do respond to crises: Lodi et al. (2023), for example, document significant increases in capital expenditure and transfers following natural disasters, with responses varying according to municipal vulnerability and resilience. More recently, D'Angeli and Gazzellone (2025) analyse the territorial distribution of NRRP funding, finding that allocations for disaster prevention and climate-change adaptation do not always align with the spatial distribution of climate risks, highlighting the need for more nuanced approaches that integrate socio-economic factors with hazard exposure.

In the Italian context, public budgets are also deeply intertwined with European funding streams, potentially shaping national investment strategies (Barca, 2009). A substantial share of capital expenditure – especially in less-developed regions (Rodriguez-Posé and Fratesi, 2004) – relies on EU cohesion policy resources (Crescenzi and Giua, 2020), and, more recently, on the extraordinary allocations of Next Generation EU. Accordingly, a significant strand of research has examined how these funds are governed, absorbed, and territorially distributed

(Crescenzi and Giua, 2016; Mendez and Bachtler, 2024; Santos et al., 2025). In addition, governance design – whether top-down mission-oriented (Mazzucato, 2018) or bottom-up place-based (Barca et al., 2012) – plays a decisive role in determining which territories are able to participate (Santos and Conte, 2024), how quickly funds are spent (Crescenzi et al., 2021), and to what effect (Foglia, 2025). In times of crisis, when public investment needs surge and administrative pressure intensifies, the capacity to mobilise and deploy EU funding becomes not just a budgetary tool but a central component of the national emergency-response architecture.

A parallel strand of literature has examined public procurement, a domain that accounts for a large share of public expenditure and becomes especially pivotal during emergencies. Studies on Italy show that procurement processes are normally sensitive to regulatory design, administrative capacity, and the degree of discretionary power granted to public buyers (Baltrunaite et al., 2023; Coviello et al., 2018; Decarolis et al., 2025) – factors that become particularly salient when ordinary procedures are suspended or relaxed in response to urgent needs. Research on disaster-driven procurement reforms, for instance, documents how expanded discretion can accelerate spending but also heighten governance risks, including reduced competition, strategic manipulation, and vulnerabilities to corruption (Fazekas et al., 2025).

This thesis contributes to this emerging literature by examining not only how resources are allocated during emergencies, but also how institutional structures and governance arrangements shape collective choices under crisis conditions. It does so through three complementary empirical analyses.

The first, “The Uneven Acceleration of Emergency Procurement: Administrative Capacity and Award-Decision Speed in the Italian Case”, investigates how the Italian administrative system responded to the COVID-19 pandemic in the domain of public procurement. By examining the timelines of procurement procedures, it evaluates whether emergency conditions led to a measurable acceleration in public purchasing, providing evidence of how crises can alter the allocation function of the budget in practice.

The second chapter, “Which Governance for an Inclusive Transition? Territorial Distribution of Cohesion Policy and NGEU Funding”, continues this focus on pandemic-related transformations in governance, investigating the shift from decentralised (bottom-up) to

centralised (top-down) policy frameworks, while also advocating for a more granular analysis of the procedural, organisational and relational configurations that structure project design, coordination and delivery (that are identified as *modes of governance*). By doing so it shows how institutional arrangements and governance designs influence which territories can access resources – highlighting the interplay between crises, allocation mechanisms, and institutional constraints.

Finally, the third empirical analysis: "Adaptive Procurement Manipulation under Varying Regulatory Thresholds: Evidence from Italian Municipalities Before and After a Natural Disaster" examines public-buyer behaviour in the aftermath of an earthquake. The chapter returns on the importance of procurement, in line with the first chapter, but analyses behaviour of public buyers after a different kind of crisis, namely the "*Central Italy Earthquake*" that struck in 2016. By exploiting emergency-induced changes in procurement thresholds, it assesses whether contracting authorities strategically adjusted contract values to circumvent competitive procedures, providing insight into how administrative behaviour mediates the realization of fiscal prerogatives under emergency conditions.

Taken together, these analyses aim to contribute to a more context-sensitive understanding of public-sector behaviour in times of emergency, showing how crises can alter the interaction between fiscal allocation, institutional quality, governance structures, and administrative capacities. The next section briefly summarises the research question, the context, and the findings of each chapter, explaining how the three compose a cohesive thesis on public action during emergencies.

1.2 First chapter – The Uneven Acceleration of Emergency Procurement: Administrative Capacity and Award-Decision Speed in the Italian Case

In the first months following the outbreak of the COVID-19 pandemic, the European Union implemented the Recovery and Resilience Facility (RRF) to provide national governments with additional funding to address the economic consequences of lockdowns and widespread closures. Access to these resources was conditional on the achievement of predefined Milestones and Targets, making the RRF a results-based policy instrument. Among these objectives was the explicit aim of reducing the duration of public procurement procedures. This framework substantially increased policy pressure on contracting authorities, which faced heightened incentives to implement projects rapidly and award contracts within compressed timeframes in order to ensure a timely response to the crisis.

The first chapter examines the impact of crisis-driven *Policy Pressure* on public procurement timeliness, focusing on the Italian National Recovery and Resilience Plan (NRRP). While procurement is a critical economic lever, award delays frequently undermine public investment goals. Using administrative data from the Italian National Anti-Corruption Agency (ANAC) for the 2016–2023 period, we analyze the universe of above-threshold tenders to test whether NRRP prioritization accelerates decisions and how this effect interacts with regional institutional quality. The paper employs a Heckman two-stage model to correct for selection bias in awarded tenders and survival analysis – including Kaplan–Meier estimates and Cox proportional hazards – to properly account for right-censored data. The findings reveal that NRRP tenders are awarded significantly faster than comparable procedures, exhibiting a 49% higher hazard of award and an average reduction in duration of approximately 30 days.

Crucially, the results confirm that institutional quality moderates this acceleration. While high-capacity administrations in Northern Italy are inherently more efficient, the "speed-up" effect of the NRRP is most pronounced in low-capacity regions. This indicates that the NRRP framework acts as a procedural equalizer, partially mitigating long-standing territorial disparities and the "institutional penalty" typical of Southern Italy. By demonstrating that policy pressure and simplified procedures can decouple procurement speed from structural institutional weaknesses, this study advances the understanding of crisis governance and highlights the potential for prioritized frameworks to temporarily overcome capacity gaps in heterogeneous territorial settings.

1.3 Second chapter – Which Governance for an Inclusive Transition? Territorial Distribution of Cohesion Policy and NGEU Funding

The second chapter also analyses the emergency context brought about by the COVID-19 pandemic, focusing on how institutional design shapes territorial inclusiveness in EU transition policies following a shift from decentralised to more centralised governance frameworks. In response to the pandemic, the European Union launched the Next Generation EU programme, financed through the RRF. This initiative was implemented in each Member State through NRRPs, which were structured around a set of common missions jointly defined by the European Commission and national governments, largely excluding local authorities from the decision-making process. This approach marked a sharp departure from the previous two decades of EU policymaking, during which regional and local authorities were actively involved in programming and implementing Cohesion Policy initiatives – the EU's flagship regional development instrument.

This change in governance paradigm raises important questions about the implications of institutional design for territorial participation. In particular, it calls attention to how implementation frameworks and project-level *modes of governance* – understood here as the procedural, organisational, and relational configurations that structure project design, coordination, and delivery – shape the ability of territories with heterogeneous socio-economic characteristics to access and benefit from transition-oriented funding.

By exploiting the coexistence of two contrasting implementation frameworks – the decentralised Smart Specialisation Strategies (S3) and the centralised National Recovery and Resilience Plan (NRRP) – the chapter assesses which approach more effectively engages with municipalities across Italy. Using project-level microdata for Italian municipalities, gathered from two open source data platforms, respectively "*Opencoesione*" and "*Italia Domani*", a multinomial logit model is estimated to test how territorial, socio-economic, and administrative characteristics influence participation. Then, to exploit the great amount of information provided in the datasets, machine-learning algorithms are applied to identify the project-level modes of governance that enable municipalities unlikely to participate under baseline conditions to access funding. This methodology enables to discover non-linear relations between variables, providing a different approach from inferential statistics.

A persistent geography of exclusion, driven by policy-choices in terms of general approach and implementation configurations, is found across both policies, favouring wealthier, more entrepreneurial and urban areas. Nonetheless, there is evidence that the top-down, mission oriented NRRP significantly increases participation in peripheral municipalities and less developed regions. In addition, machine-learning results show that inclusiveness depends not on implementation frameworks alone, but on specific governance configurations – particularly streamlined project design, centralised leadership, and public–private cooperation robustly predict inclusiveness. The findings offer new evidence on how institutional architecture shapes the territorial reach of transition policies and inform the design of a post-2027 Cohesion Policy.

1.4 Third chapter – Adaptive Procurement Manipulation under Varying Regulatory Thresholds: Evidence from Italian Municipalities Before and After a Natural Disaster

The third chapter examines how public administrations strategically adapt their procurement behaviour when regulatory discretion is unexpectedly expanded during emergencies. It focuses on the 2016 Central Italy earthquake, which triggered exceptional procurement provisions allowing affected municipalities to use simplified and less competitive procedures for contracts below a newly introduced emergency threshold. This sudden and exogenous regulatory shift provides a unique opportunity to study how contracting authorities internalise and operationalise increased flexibility during crisis conditions.

Drawing on contract-level data from all municipalities in the Marche region between 2014 and 2018 – covering both pre and post-earthquake periods – the chapter investigates whether public buyers adjust contract values to remain just below applicable thresholds. Building on research showing that emergencies expand discretion and heighten corruption risks (Fazekas et al., 2025) as well as on the literature documenting "bunching below thresholds" in normal times (Palguta and Pertold, 2017; Coviello et al., 2018), the analysis first confirms that municipalities systematically concentrate tenders just below ordinary cutoffs even in non-emergency conditions. It then shows that this behaviour shifts during the earthquake-induced emergency, with contracting authorities adapting their strategies to the newly introduced thresholds – evidence that thresholds exert a powerful and dynamic influence on procurement decisions.

To identify the causal effect of expanded emergency discretion, the chapter exploits the earthquake shock and the associated regulatory reform. A combination of coarsened exact matching and nonparametric density tests reveals clear discontinuities in contract value distributions only in affected municipalities and precisely at the new emergency threshold. This pattern – absent in unaffected municipalities – indicates that public buyers rapidly internalised the new rules and adapted their behaviour by shifting manipulation to the newly relevant cutoff. The response is particularly pronounced for service contracts, while goods contracts exhibit weaker or more ambiguous effects, suggesting heterogeneous behavioural dynamics across procurement categories.

A triple difference in difference framework further explores the implications of this strategic behaviour. By comparing treated and untreated municipalities, contracts below and

above thresholds, and periods before and after the earthquake, the analysis demonstrates that those municipalities already inclined to bunch under ordinary rules significantly increased their use of direct awards once emergency thresholds were relaxed. This finding implies not only that threshold manipulation intensified under emergency conditions but also that the behavioural effects of regulatory discretion are highly uneven across administrations.

Overall, the chapter shows that emergency procurement provisions are not implemented passively: public buyers strategically adapt to the expanded discretionary margins made available during crises. This behavioural mechanism underscores how rules designed to accelerate procurement in emergencies – by raising thresholds and simplifying procedures – may inadvertently create opportunities for opportunistic behaviour. By identifying how and why threshold manipulation evolves under crisis conditions, the chapter contributes to a more nuanced understanding of administrative behaviour during emergencies and reinforces the thesis's broader argument that crises actively reshape the incentives and conduct of public institutions.

1.5 Conclusions

This thesis provides a comprehensive analysis of public action during and after emergencies. By examining three distinct instances in which public intervention changed following a crisis, it brings to light a set of critical issues, while also offering insights into the complex socio-economic dynamics that shape public decision-making and policy implementation under exceptional circumstances.

While each chapter presents evidence in its own right as an individual analysis, together they reveal a number of common lessons concerning public intervention during and after crises. First, the thesis finds that policy pressure can accelerate decision-making processes within local contracting authorities, with the strongest effects observed in contexts characterized by lower institutional quality. Second, it shows that forms of centralization may enable a broader set of territories to participate in public policies – particularly those that were ex ante less likely to do so – through streamlined decision-making, centralized leadership, or the fostering of public–private collaboration. At the same time, alternative governance arrangements – often normatively aligned with participatory or place-based approaches – may inadvertently reproduce or reinforce existing spatial inequalities.

Moreover, the analysis of adaptive behaviour in the aftermath of an earthquake reveals that contracting authorities with a pre-crisis propensity to rely on simplified and less competitive procedures respond particularly strongly when emergency legislation relaxes regulatory thresholds. Expanded discretion under crisis conditions interacts with established administrative practices, leading to systematic adjustments in procurement behaviour. In this way, crises act as accelerators of pre-existing patterns, revealing how institutional flexibility and administrative routines jointly shape the allocation of public resources when procedural constraints are loosened.

Taken together, these results show how governance structures and decision-making behaviour shape the allocative role of public spending (Musgrave, 1959) in practice, especially under conditions of emergency. The thesis sheds light on the procedural and institutional mechanisms through which public resources are allocated across territories and actors. Its contribution is therefore primarily empirical, complemented by a conceptual perspective that emphasises how crises expose implementation trade-offs and governance frictions that condition the operation of public finance beyond its formal rules.

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The Uneven Acceleration of Emergency Procurement: Institutional Quality and Award-Decision Speed in the Italian Case

Giacomo Gazzellone

Abstract

This study examines the impact of crisis-driven *Policy Pressure* – defined as a shift in administrative behaviour whereby officials prioritise strategic tenders and accelerate routine decision-making processes – on public procurement timeliness, focusing on the Italian National Recovery and Resilience Plan (NRRP). While procurement is a critical economic lever, award delays frequently undermine public investment goals. Using administrative data from the Italian National Anti-Corruption Agency (ANAC) for the 2016–2023 period, we analyze the universe of above-threshold tenders to test whether NRRP prioritization accelerates decisions and how this effect interacts with regional institutional quality. The paper employs a Heckman two-stage model to correct for selection bias in awarded tenders and survival analysis – including Kaplan–Meier estimates and Cox proportional hazards – to properly account for right-censored data. The findings reveal that NRRP tenders are awarded significantly faster than comparable procedures, exhibiting a 49% higher hazard of award and an average reduction in duration of approximately 30 days.

Crucially, the results confirm that institutional quality moderates this acceleration. While high-capacity administrations in Northern Italy are inherently more efficient, the "speed-up" effect of the NRRP is most pronounced in low-capacity regions. This indicates that the NRRP framework acts as a procedural equalizer, partially mitigating long-standing territorial disparities and the "institutional penalty" typical of Southern Italy. By demonstrating that policy pressure and simplified procedures can decouple procurement speed from structural institutional weaknesses, this study advances the understanding of crisis governance and highlights the potential for prioritised frameworks to temporarily overcome capacity gaps in heterogeneous territorial settings.

JEL Classification: D73, H57**,** H83

Keywords: Public procurement, NRRP, institutional quality.

2.1 Introduction

Public procurement refers to the process by which public authorities, such as government departments or local authorities, purchase work, goods or services from companies[1] and represents one of the most significant channels through which governments allocate resources and stimulate economic activity (Bosio et al., 2022; OECD, 2021). However, to achieve its goal, the award of public contracts has to comply with some principles such as timeliness, transparency, competition and cost control (Directive 2014/24/EU) which have been widely studied by related literature for their centrality for effective implementation (e.g. Tas, 2020; Mwesiumo et al., 2025). In particular, despite the significant effects related to award delays such as reduced governments' ability to deliver public investments, threat to competition, increase transaction costs, and constrain the capacity to meet strategic commitments "delay in the award of public procurement contracts is under-researched" (He et al., 2023). Recent literature highlights two broad reasons why decision speed merits greater attention. First, procurement systems are increasingly exposed to pressure for rapid action, whether generated by crises, urgent programmes, reforms, or performance-driven policy frameworks. Under such circumstances, organisations shift governance strategies, reallocate managerial attention and adapt routines to deliver more quickly (Grandia & Warsen, 2023). Yet, despite these dynamics, we still lack systematic evidence on whether *Policy Pressure* – defined as a shift in administrative behaviour whereby officials prioritise strategic tenders and accelerate routine decision-making processes – actually accelerates procurement award decisions, and under what conditions acceleration occurs.

Furthermore, in contexts characterised by urgency, policy prioritisation and turbulence applicability of tender principles could be complicated by socio-political, temporal and economic pressure which could give rise to governance issues (Grandia and Warsen, 2023; Glas et al., 2025). A growing body of research shows that decision speed reflects diverse organisational, procedural and contextual factors. Studies demonstrate that timing varies with contractual complexity, award mechanisms, market structures, organisational capacity and red tape (He et al., 2023; Glas et al., 2025). Evidence from the European Single Market further shows that decision speed masks substantial underlying variation depending on the type of contract, procurement procedure and characteristics of contracting authorities (Prier et al., 2020). These insights indicate that decision speed is far from a simple indicator of efficiency and should instead be conceptualised as the outcome of a complex governance process. The

Italian case offers a fruitful example on this issue. Public procurement plays a central role in investment and service delivery, particularly in infrastructure and local development (Bandiera et al., 2009; Decarolis & Giorgiantonio, 2022) but the efficiency and equity of procurement processes vary substantially across regions, reflecting long-standing administrative, institutional, and socio-economic divides (Coviello & Mariniello, 2014). Such difference may turn to be important determinant of public procurement performance especially in times of emergency when public procurement faces the central dilemma to ensure urgent action without disregarding regulatory safeguards (Glas et al., 2025). In 2020, the COVID-19 crisis triggered an unprecedented fiscal response across Europe. The European Union's Next Generation EU (NGEU) program, put into practice by each Member State (MS) through National Recovery and Resilience Plans (NRRP), of which Italy was among the largest recipients, with an allocation exceeding €190 billion[2] (European Commission, 2024). The extraordinary conditions occurred from the pandemic raise an important empirical question: did the emergency prioritization embedded in the NRRP translate into faster procurement execution, and if so, did its effects vary across Italy's regional divide?

This work aims at developing and testing a capacity-moderated model of procurement acceleration by analysing how policy prioritisation affects the time-to-award of procurement procedures at a sub-national level, also considering a possible changing award behaviour due to a crisis time. Using the universe of Italian above-threshold tenders (2016–2023), we estimate how *Policy Pressure* affects award duration and whether Institutional Quality conditions these effects across territories exploiting detailed administrative data from the Italian National Anti-Corruption Agency (ANAC). Novelty of the paper is two-fold:

1) First of all, we compare normal with crisis times. By comparing NRRP-related and non-NRRP tenders, the paper estimates the extent to which the emergency framework affected the duration of the award phase – an essential indicator in procurement (*Single Market Scoreboard*, European Commission, 2017).
2) To the best of our knowledge this is the first attempt which explores whether acceleration is uniform or territorially uneven in countries characterised by strong regional differences in institutional quality. Italy provides a compelling setting for this analysis: territorial heterogeneity is investigated to assess whether the long-standing North-South divide also manifests in the award period, thereby shedding light on the capacity of local administrations to respond to crisis-driven prioritisation.

To estimate the effect on procurement timeliness, the analysis employs a Heckman two-stage model – accounting for selection bias of awarded tenders, as further explained in Section 6 – focusing on open-procedure, over-threshold tenders. In a complementary framework, a survival analysis traces the dynamics of time-to-award, allowing a detailed comparison of the hazard and survival functions for NRRP and non-NRRP tenders across Italy's macro-regions. The results indicate that NRRP tenders were awarded significantly faster than comparable non-NRRP tenders. On average, results from the Heckman two-stage model show that NRRP-related procedures were completed roughly 30 days earlier than the non-NRRP tenders. To validate and enrich these findings, a survival analysis estimates and compares the duration of the award phase across both groups. To account for observable heterogeneity, a Cox proportional hazards model is estimated including covariates such as the number of admitted offers, contract type, sector, regional dummies, NRRP status, log of per capita GDP, population density, and tertiary education rate.

This approach combines a non-parametric estimation (Kaplan–Meier and Nelson–Aalen) followed by semi-parametric Cox regression, allowing both descriptive comparison of time-to-award distributions and estimation of hazard ratios controlling for relevant covariates. It therefore allows for a more in-depth analysis of the award period than the Heckman two-stage model.

Kaplan–Meier estimates show that by 300 days about 50% of NRRP tenders had been awarded compared to ~35% of non-NRRP tenders, and the median time-to-award for NRRP tenders is approximately 309 days while the median for non-NRRP tenders is not reached within the observation period – indicating substantially faster award timing for NRRP procedures. The log-rank test rejects equality of the survival curves. Consistently, a Cox proportional hazards model indicates that NRRP tenders have a 49% higher hazard of being awarded than non-NRRP tenders, controlling for contract type, sector, and region.

Moreover, regional disparities in the efficiency of public procurement emerge clearly from the survival patterns of tenders across Italian macro-areas. The Kaplan–Meier estimates show that tenders launched in the northern regions are resolved substantially faster than those in the Centre, South, and Islands. While all regions experience a rapid initial decline in unresolved procedures, the gap between areas with stronger institutional quality and those with weaker institutions appears early and persists over the entire duration distribution. These differences point to systematic heterogeneity in the functioning of public administrations, suggesting that institutional quality and bureaucratic capability play a central role in shaping

the speed and predictability of procurement processes. The observed patterns align with a broader body of evidence indicating that territorial variation in state capacity can meaningfully influence the effectiveness of public spending and the implementation of investment programs.

Overall, the results indicate that prioritised tenders are awarded substantially more rapidly than comparable procedures, but the magnitude of this acceleration is strongly conditioned by institutional quality. In fact, our findings show that *Policy Pressure* mitigates chronic regional disparities in institutional quality, revealing a pattern of diminishing returns, whereby the speedup effect observed in low institutional quality regions progressively shrinks as the quality of government improves.

These findings advance our understanding of procurement performance under pressure and highlight the limits of simplification tools when structural capacity gaps remain.

The remainder of the paper proceeds as follows. Section 2.2 situates the study in the literature, highlighting the gaps it tries to fill. Section 2.3 presents the theoretical framework, while Section 2.4 defines the decision period. Section 2.5 and 2.6 describe the data and empirical strategy, including the Heckman selection model and survival analysis framework. Section 2.7 presents the main results and regional heterogeneity analysis. Section 2.8 presents some robustness checks. Finally, Section 2.9 discusses the implications for policy design and long-term institutional capacity.

2.2 Literature review

A substantial interdisciplinary literature recognises public procurement as a key instrument through which governments allocate resources and shape economic activity, with important implications for service delivery, territorial development, innovation, and broader economic governance (Uyarra & Flanagan, 2010; Pickernell et al., 2011; Loader, 2013; Cernat & Kutlina-Dimitrova, 2015; Mazzucato et al. 2015; Andreoni and Chang, 2016; Kutlina-Dimitrova & Lakatos, 2016; Flynn & Davis, 2016).

Given its considerable share in public expenditure, procurement performance hinges on adherence to core governance principles – timeliness, competition, and cost control – codified in Directive 2014/24/EU and extensively examined in empirical and policy-oriented research (OECD, 2019; Tas, 2020; Bosio et al., 2022; Mwesiumo et al., 2025).

While a rich body of work has documented inefficiencies in procurement, existing studies have predominantly focused on costs, quality, and corruption (Laffont & Tirole, 1993;

Crowley & Hancher, 1995; Levin, 2016; Xu & Tiong, 2001; Bandiera et al., 2009), devoting comparatively less attention to the timeliness of contract award – a key performance metric especially critical in crisis-response contexts (Baltrunaite et al., 2021).

Despite the growing interest, the award phase itself remains understudied despite its centrality in determining how rapidly public contracts can be mobilised (Carlucci et al., 2019; Frigo & Mocetti, 2025). Emerging evidence indicates that decision speed varies with contractual complexity, award criteria, market structure, and procedural design (He et al., 2023; Glas et al., 2025). Research on crisis governance similarly suggests that organisations facing urgent programmes or exceptional pressures may shift routines, reallocate managerial attention, and redesign decision processes to accelerate implementation (Grandia & Warsen, 2023). However, it remains unclear whether such pressures generate genuine acceleration or simply induce procedural shortcuts, and under which conditions speed gains materialise (Casady et al., 2023). Further evidence from the European Single Market shows that aggregate indicators mask substantial underlying heterogeneity across procurement procedures, contract types, and contracting authorities (Prier et al., 2021). This evidence suggests that decision speed is not a straightforward metric of efficiency but the outcome of a complex interplay between organisational capacity, procedural rules and contextual factors.

A parallel strand of research highlights the role of institutional and territorial heterogeneity in shaping procurement outcomes. In countries characterised by persistent regional disparities in institutional quality (Kaufmann et al., 2011; Charron et al., 2014), performance gaps emerge in competition intensity, compliance, and implementation effectiveness (Coviello & Mariniello, 2014; Bandiera et al., 2009; Decarolis & Giorgiantonio, 2022). The Italian case exemplifies these dynamics: while procurement plays a pivotal role in infrastructure investment and local development, award times, administrative quality, and governance practices vary markedly across regions (Nifo and Vecchione, 2013; Charron et al., 2024; Cerqua et al., 2025). Such disparities become particularly salient in periods of urgency, when procurement systems face the dual imperative of ensuring rapid action while adhering to regulatory safeguards (Glas et al., 2025). Yet existing studies have not examined whether extraordinary *Policy Pressure* – such as that generated by the National Recovery and Resilience Plan (NRRP) – can overcome or exacerbate structural territorial divides.

Despite important advances, two gaps remain. First, we lack causal evidence on whether crisis-driven policy prioritisation accelerates procurement decision-making relative to normal periods. Second, no study has tested whether such acceleration is homogeneous across

territories with varying levels of institutional quality. These gaps are central for understanding the effectiveness of large-scale investment programmes, particularly in contexts characterised by strong regional heterogeneity in institutional quality.

2.3 Theoretical framework

Public organisations increasingly operate under conditions of turbulence – characterised by crises, urgency, shifting priorities and compressed timelines. Under such pressure, procurement processes may need to be adapted: routines become more flexible, governance strategies shift, and managerial attention is reallocated to accelerate critical stages (Grandia and Warsen 2023). *Policy Pressure* may influence award timing through: stronger incentives for rapid decision-making; reduced tolerance for administrative delay; prioritisation of strategic tenders; use of simplified procedures or exceptional rules.

In theory, these mechanisms should accelerate award decisions. In practice, their effectiveness depends on how organisations cope with pressure and complexity.

Empirical research shows that award duration varies systematically with features of both contracting authorities and contracts. According to recent evidence (He et al., 2023): organisational experience enhances evaluation efficiency; centralised structures often award more quickly; competition volumes and award mechanisms influence evaluation time; contract complexity increases deliberation and slows decision-making. Red tape can also significantly harm decision speed (Glas et al., 2025) which can differ across contract types, procedures and contracting authorities (Prier et al., 2021). Earlier strands suggest that award timing reflects underlying organisational and contractual conditions. Institutional Quality has long been recognised as a fundamental driver of procurement performance. It enables public buyers to: manage complex evaluations; process bids efficiently; exploit simplified procedures; coordinate internal processes effectively. However, assessing the impact of crisis governance requires formally disentangling Institutional Quality from Administrative Capacity. While a broad institutional metric captures the systemic environment and dictates the structural friction of a region (effectively setting the baseline hazard rate of a tender), it inherently obscures micro-level administrative variations. Administrative capacity, conversely, concerns the granular, short-to-medium-term organizational capability of specific contracting authorities, driven by human capital, IT infrastructure, and internal routines. While overarching institutions set the long-term trajectory, they do not change overnight; therefore, the actual acceleration

mechanism triggered by Policy Pressure is likely executed through the administrative margin. Targeted administrative shocks – such as the PNRR's procedural simplifications or the injection of dedicated technical personnel – can temporarily decouple a specific contracting authority's execution speed from its region's broader institutional destiny

We theorise that Institutional Quality moderates the influence of *Policy Pressure* on award duration. On the one-hand, while high-quality institutions could translate pressure into actual acceleration, low-capacity authorities may be unable to respond to emergency needs, resulting in limited or no acceleration. Conversely, if *Policy Pressure* has greater influence than institutional quality, territories with low-quality institutions might exhibit greater gains, with high-quality territories finding less advantage. This produces uneven acceleration, particularly across Italy that is characterised by institutional quality divides.

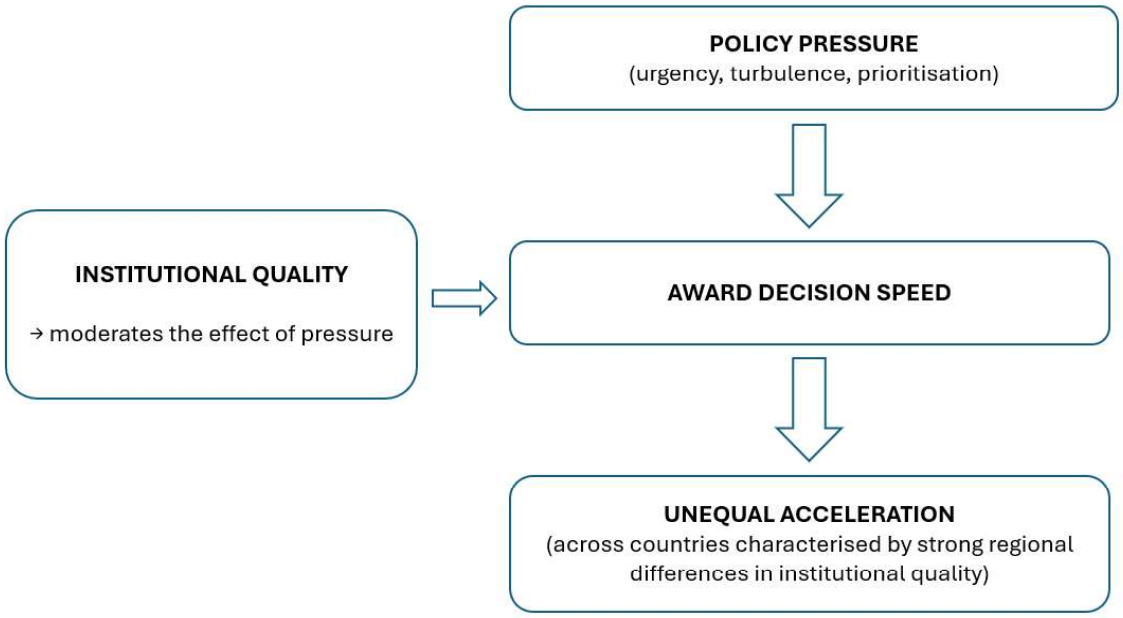
Therefore, building on previous analyses, we formulate two main hypotheses:

H1: *Policy Pressure*, like NRRP framework, increases award assignment speed.

H2: Institutional Quality moderates the magnitude of acceleration brought about by *Policy Pressure*.

The following diagram (Figure 1) illustrates how *Policy Pressure* (generated by turbulence, urgency and prioritisation) activates acceleration mechanisms such as procedural simplification. Baseline determinants (organisational experience, complexity, competition) shape the intrinsic difficulty of the award phase. Institutional Quality moderates the effect of pressure on actual award-decision speed, resulting in uneven acceleration across contracting authorities and territories.

Figure 1 - A quality-moderated model of award-decision acceleration under *Policy Pressure* and Institutional Quality.



2.4 Decision Period: Definition and Measurement

To assess the efficiency of public procurement processes, the European Commission has developed a suite of indicators assembled within the Single Market Scoreboard (European Commission, 2017). This study builds on that framework and proposes methodological refinements to enhance the accuracy of performance evaluation. Particular attention is devoted to the *award period* – defined as the number of days between the bid submission deadline and the contract award date – which represents a critical juncture linking the design phase of a tender to its implementation.

Consistent with the Commission's approach, the dataset is cleaned to minimize the influence of anomalies and outliers. Observations are restricted to positive award durations and capped at 730 days to exclude tenders with implausible or irregular timelines.

The paper's central contribution lies in demonstrating that this standard approach may insufficiently represent the underlying population of tenders. Because it considers only contracts with both award and bid submission dates, it systematically excludes tenders that have not yet been awarded – potentially biasing estimates of decision-making speed. To address this challenge, the analysis adopts two complementary strategies.

First, the Heckman two-step model (Heckman, 1979) is applied to correct for sample-selection bias by explicitly modelling the probability that a tender is awarded. While the method has been used in procurement research – for example, by Frigo and Mocetti (2025) to examine the effects of e-procurement adoption – it has not previously been employed to adjust for bias in the estimation of award periods.

Second, the study incorporates survival analysis to exploit the time-to-event nature of award processes and to properly account for right-censoring arising from tenders that remain unawarded. Survival models enable the estimation of hazard rates for award decisions and provide a complementary perspective on the dynamics of administrative processing times. Together, the Heckman correction and survival analysis yield a more comprehensive and unbiased evaluation of tender award timelines. Further methodological details are provided in Section 6.

A key premise of the analysis is that tenders constitute unique, non-repeated observations: each tender is bound to a specific point in time and space and cannot be observed longitudinally without aggregation. Because the objective is to provide the most granular assessment possible, any aggregation at the tender level would undermine this aim.

The choice of procurement procedure is particularly consequential for award durations, as direct awards are inherently faster than open procedures. To ensure comparability, the study restricts the sample to above-threshold tenders subject to standardized procedures. All tenders analysed thus share the same adjudication rules and fall within the same value bracket. Special care is taken in identifying above-threshold tenders, as threshold values vary over time in response to changes in European legislation. Table 1 reports the applicable thresholds across the relevant periods.

Table 1 – Thresholds across 2016-2023

Tenders	**2016-2017**	**2018-2019**	**2020-2021**	**2022-2023**
Works	5,225,000€	5,4548,000€	5,350,000€	5,382,000€
Ordinary goods and services	135,000€	144,000€	139,000€	140,000€
Special goods and services	418,000€	443,000€	428,000€	431,000€

2.5 Data and descriptive statistics

The dataset used in this analysis is drawn from the open-source procurement database maintained by the Italian National Anti-Corruption Agency (ANAC). Data were extracted in December 2024 and include all open-precedure tenders with an estimated value above €40,000 published between January 2016 and December 2023.

This period is selected because it corresponds to the regulatory regime established under the Public Procurement Code (D.Lgs. 50/2016), which governed all procurement procedures except those implemented through the National Recovery and Resilience Plan (NRRP). NRRP tenders followed a set of simplified procedures later extended to all tenders by Legislative Decree 36/2023. This regulatory distinction creates a natural "treated" group – NRRP tenders – that can be explicitly controlled for in the empirical models. Identification of NRRP tenders is achieved through a merge with the open-source database, "*Italia domani*", maintained by the Italian Ministry of Economy and Finance. The dataset contains information on the object of the tender, the tendered amount, the award criteria, and the sector of activity; a detailed description of these variables is provided in Table 2. Regional location is proxied using the ANAC office responsible for reporting each procedure. Observations lacking this information cannot be geographically assigned and are therefore removed from the final sample.

Crucially, the reliance on regional institutional quality rather than micro-level administrative capacity is an intentional methodological choice dictated by the structural heterogeneity of the ANAC dataset. Because the sample encompasses the universe of above-threshold tenders, the contracting authorities involved represent a vast multiplicity of public bodies – ranging from small municipalities to large regional health authorities (ASLs), provincial bodies, and central government branches. Utilizing a municipal-level administrative capacity metric would suffer from severe coverage bias and scale mismatch, fundamentally failing to capture the execution dynamics of non-municipal entities that handle a significant share of high-value public procurement. Consequently, regional institutional quality serves as a necessary systemic proxy. It captures the overarching governance ecosystem, legal certainty, and baseline efficiency within which all these diverse contracting authorities operate, providing a macro-level measure of the structural 'rules of the game' rather than the localized organizational capability of any single public buyer.

Table 2 – ANAC variables description

Variable	Description
Main object of the tenders	Each tender can either be a work, a supply or a good.
Amount of money tendered	Reports the base amount of money tendered and not the actual awarded amount
Awarding criteria	Describes the criteria with which the tender has been awarded, there are 5 different types
Sector	The tender can either be in the ordinary sector of the special sector, the second is defined by the Public Procurement Code

The resulting dataset consists of 433,419 tenders, all conducted through open procedures. Table 3 shows that Goods account for 53 percent of the sample, followed by Services (35 percent) and Works (12 percent). Fewer than 10 percent of procedures fall within the Special Sectors – energy, transport, postal services, and water supply and management – as defined by EU Directive 2014/25 and subsequently incorporated into Italian law under D.Lgs. 50/2016 and updated by D.Lgs. 36/2023 (Table 4).

Table 3 – Distribution of tenders by main object

Main object of the tenders	Number	Percentage
Works	51,814	11.95
Goods	228,036	52.61
Services	153,569	35.43
Total	433,419	100.00

Table 4 – Number of tenders by object and sector

Sector	**Works**	**Goods**	**Services**	**Total**
Ordinary	47,638	217,017	139,232	403,887
Special	4,176	11,019	14,337	29,532

Five mutually exclusive award criteria are identified, each corresponding to a distinct administrative procedure. These criteria are retained at their most disaggregated level to capture procedural nuances that may influence decision-making times – differences that would be obscured under broader categorical groupings.

As noted in Section 4, concerns about selection bias are particularly salient when examining the distribution of award information. Table 5 shows that 57 percent of tenders lack recorded award criteria, either because they have not yet been awarded or because the award information has not been transmitted by contracting authorities to ANAC. Among tenders with available

information, the Best Quality/Price Ratio is the most frequently used criterion, while Lowest Price accounts for roughly 15 percent of awarded procedures. The Economically Most Advantageous Offer enables contracting authorities to weigh both quality and cost by introducing technical evaluation criteria that foster more substantive comparisons across bids.

Table 5 – Number of tenders by award criteria

Award criteria	Works	Goods	Services	Total
Missing	17,997	148,863	87,230	254,090
Economically Advantageous Offer	6,821	19,892	22,775	49,488
Economically Advantageous Offer (Qualitative Criteria Only)	107	163	1,232	1,502
Economically Advantageous Offer (Lowest Price)	8,647	24,908	8,899	42,454
Economically Advantageous Offer (Best Quality/Price Ratio)	8,629	23,348	27,474	59,451
Lowest Price	9,613	10,862	5,959	26,434

Table 6 further documents the status of award outcomes, confirming again that missing information is substantial (57 percent). The number of missing award outcomes is slightly lower than the number of missing award criteria, suggesting that some tenders are registered as awarded but lack information about the specific criterion used.

Table 6 – Number of tenders by award outcomes

Result	Works	Goods	Services	Total
Missing	17,097	146,925	83,896	247,918
Awarded	34,714	81,111	69,668	185,493
Revoked	1	0	2	3
Deserted	0	0	1	1
Without result	2	0	2	4

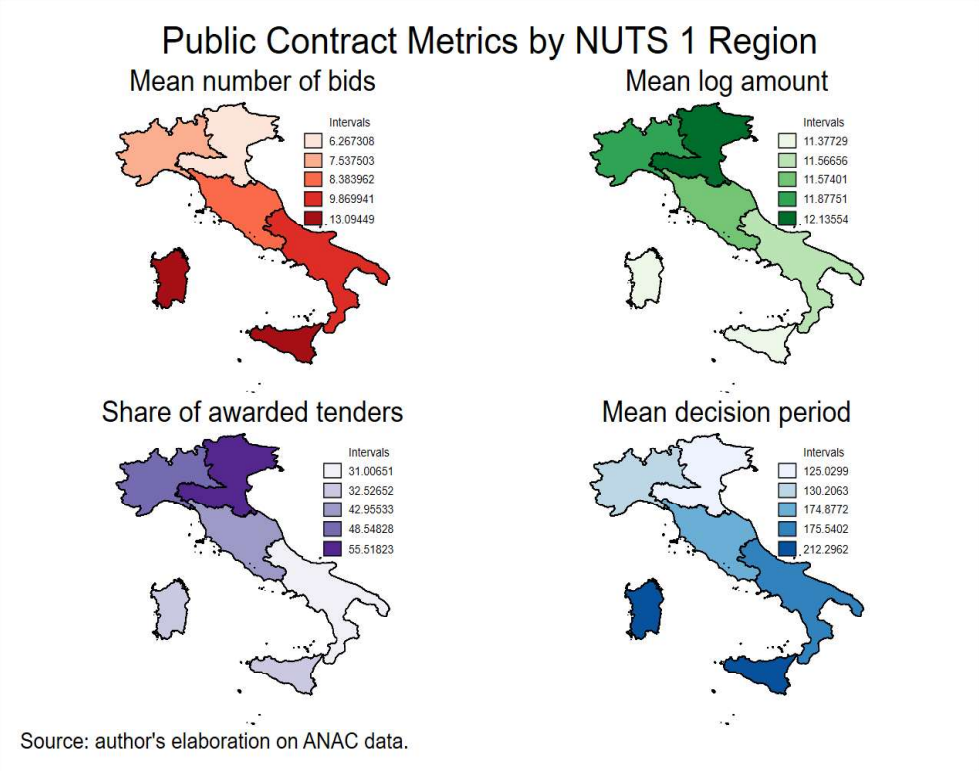
The tendered amount is an important dimension for understanding both the economic implications of delays (Baltrunaite et al., 2024) and the probability of contract award. Table 7 shows that mean tender values are highest for Works, followed by Services and then Goods. All distributions are heavily right-skewed: mean values exceed medians, and variance is considerable, reflecting the presence of very large tenders. To mitigate this skewness, the amount is log-transformed in subsequent analyses.

Table 7 – Amount tendered by object

Amount tendered (€)	Works	Goods	Services
Observations	51,814	228,036	153,569
Mean	4,065,585	1,182,511	2,329,650
Median	584,645.1	66,480.5	284,644.4
Variance	8.91e+15	2.49E+14	4.82E+14
Skewness	172.1417	212.7987	78.99613
Kurtosis	33,628.75	71,593.46	9,153.8

Finally, Figure 2 highlights territorial disparities across Italy's NUTS-1 regions in terms of the number of admitted bids, the log-transformed mean tender value, the share of tenders awarded, and the average decision period for awarded tenders. A pronounced North–South divide emerges across all indicators. Tenders in the North and Centre exhibit higher average values than those in the South and Islands. Award rates differ markedly: the South awards roughly 20 percent fewer tenders than the North-East. Average decision periods are significantly longer – by 50 days in the South and 87 days in the Islands – although the latter may partly reflect higher average bid volumes, as tenders in the Islands receive twice as many bids as those in the North-East. These descriptive patterns point to substantial geographic disparities in Italy's procurement landscape. To formally test the hypotheses arising from these descriptive findings, the methodological section presents a more rigorous econometric strategy.

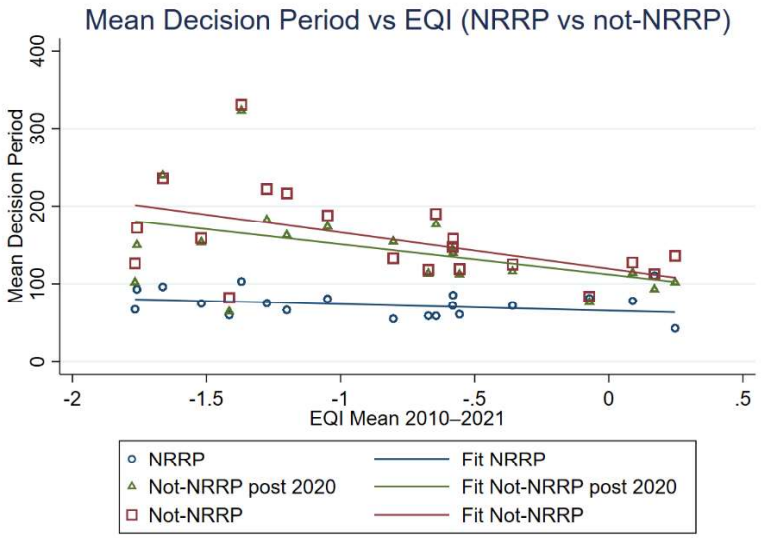
Figure 2 – author's elaboration of ANAC data



2.5.1 Decision period: NRRP vs not NRRP tenders across Quality of Government

Figure 3 presents a descriptive summary of the conditional relationship between institutional quality and procurement efficiency, measured by the Mean Decision Period by Region. Institutional quality is quantified using the European Quality of Government Index[3] (EQI), a parameter developed for the European Commission by Charron et al. (2024). For this analysis, we employ the average EQI value between 2010 and 2021 to capture persistent regional institutional capacity, where the index is normalized around the EU average (positive values indicate above-average quality). The figure immediately reveals a significant structural difference in how local institutional quality impacts the processing time for NRRP contracts relative to conventional, non-NRRP tenders. This disparity suggests that the NRRP program alters the fundamental role of high quality governance in determining public procurement speed and insulates the procurement process from low institutional quality.

Figure 3 – mean decision period and Quality of Government – author's elaboration of ANAC and Italia Domani data



The most evident observation is the strong vertical separation between the three fitted lines: NRRP-funded contracts consistently and substantially exhibit a faster Mean Decision Period (lower duration) across the entire observed range of the EQI distribution, visually confirming the primary finding that NRRP contracts are generally faster. The non-NRRP contracts show a much higher average duration, frequently exceeding 200 days in regions with poor institutional quality.

The key to the policy's effectiveness lies in the disparity between the slopes. For conventional, non-NRRP contracts (Red line), the steep negative slope confirms that regional institutional quality is a critical factor; poor institutional quality (low EQI) leads to significant processing delays, while high EQI substantially shortens the duration. The same is true for the not-NRRP contracts from 2020 onwards (Green line), that share the same timeframe as the NRRP projects, therefore validating the findings. In contrast, the fitted line for NRRP contracts (Blue line) is nearly flat, visually confirming that the marginal effect of local EQI on NRRP duration is minimal or insignificant. This indicates that the NRRP's framework increases award assignment speed, confirming H1 (Policy Pressure decreased overall procurement duration), and moderates the procurement process from regional institutional deficiencies (Charron et al., 2014), supporting H2 (Institutional Quality moderates acceleration from Policy Pressure), imposing a high-efficiency standard regardless of institutional capacity.

Consequently, the largest vertical gap between the two lines – representing the maximum speedup benefit of the NRRP – occurs in regions with the lowest EQI. This strongly supports the interpretation that the NRRP acts as a powerful institutional stabilizer, providing the greatest institutional "boost" to the weakest-governed regions. Conversely, in the highest EQI regions, the gap narrows, as the NRRP only offers marginal additional gains over already more efficient awarding phases. The overall pattern is consistent with an effective policy intervention designed to mitigate regional disparities by providing a procedural substitute for low institutional capacity.

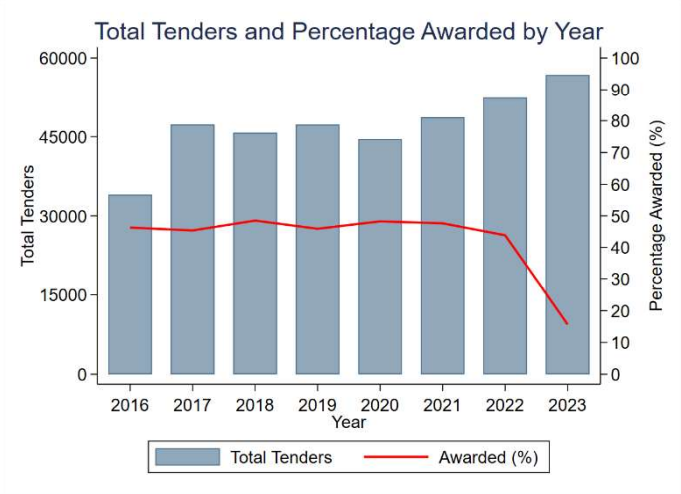
This descriptive evidence, while being informative, lacks the necessary control for bias entailed in the data-structure, where the decision period can only be calculated on the awarded tenders, and therefore cannot account for those that have not been awarded. For this reason in the next section we present the methodology, where we use the Heckman two-step model that enables the correction for the bias.

2.6 Methodology

2.6.1 Heckman Two-Step Model

To address the research question, this study employs the Heckman two-step model (Heckman, 1979), a statistical approach designed to correct for selection bias. Selection bias is particularly relevant in this context because tenders that have not yet been awarded—either because the decision has not been taken or has not been communicated—are excluded from the calculation of the award period, thereby distorting assessments of decision-making efficiency. As shown in Figure 3, the share of awarded tenders remains well below completeness across all years, fluctuating around 50 percent until 2022 and then dropping sharply in 2023. This sudden decline is likely driven by reporting delays rather than substantive changes in administrative performance, underscoring the importance of correcting for non-random missingness when estimating award durations.

Figure 3 – Number of tenders and percentage of awarded tenders by year – author's elaboration of ANAC data



The model consists of two stages. At first the Selection Equation estimates the probability of a tender being awarded, considering factors such as contract type, geographical location, and awarding criteria.

$$Z^* = \gamma_1(\log\ amount) + \gamma_2(primary\ object) + \gamma_2(sector) + \gamma_3(geographical\ area) + \varepsilon \quad (1)$$

Then the Outcome Equation analyses the determinants of the decision period for tenders that were awarded, correcting for the selection bias identified in the first stage.

$$Y = \beta_1(number\ of\ bids) + \beta_2(award\ criteria) + \beta_3(NRRP\ tender) + \beta_4(EQI) + \beta_5(NRRP\ tender\ x\ EQI) + \rho \cdot \lambda + \upsilon \quad (2)$$

Where λ is the inverse mills ratio, that is calculated as:

$$\lambda = \frac{\phi(\gamma_1\ primary\ object + \cdots)}{\Phi(\gamma_1\ primary\ object + \cdots)} \quad (3)$$

That is the ratio between the probability density function and the complementary cumulative distribution function.

The Heckman model jointly estimates the likelihood that a tender is awarded and the determinants of the decision period, thereby correcting for non-random selection into the observed sample of awarded tenders. This approach yields an unbiased estimate of award durations while controlling for confounding factors that influence both the probability of award and the timing of the decision.

The interpretation of the model centres on two key sets of coefficients that directly correspond to our hypotheses. First, Hypothesis 1 (P*olicy Pressure accelerates award decisions*) is evaluated through the coefficient β_3, which captures the effect of NRRP prioritisation in the outcome equation. A negative and significant β_3 indicates faster award assignment for prioritised tenders, conditional on selection. Second, Hypothesis 2 (*Institutional Quality moderates acceleration*) is assessed through the interaction term between NRRP and Institutional Quality in the outcome equation, which identifies whether the effect of *Policy Pressure* varies across territories with different levels of capacity.

In addition, the model includes award criteria and other covariates as factor variables, generating a set of coefficients that represent the influence of each category relative to its reference level. In the selection equation, these coefficients indicate how tender characteristics affect the probability of being awarded, while in the outcome equation they reflect their contribution to the duration of the decision process. This structure enables us to jointly analyse both the likelihood of award and the determinants of award timing, correcting for potential selection bias through the Heckman two-step approach.

2.6.2 Survival Analysis

To further investigate and validate the differences in the timing of tender awards, we employ survival analysis methods, which allow us to account for both the occurrence and the timing of events. First, we estimate Kaplan–Meier survival curves to visualize the cumulative probability of contract award over time, stratified by NRRP participation and other key covariates. This nonparametric approach provides an intuitive comparison of survival functions across groups, and we formally test differences using the log-rank test.

$$\hat{S}(t) = \prod_{t_i \leq t} (1 - \frac{d_i}{n_i}) \tag{4}$$

Where t_i is the observed event times, that is the tender award times, d_i is the number of awards at time t_i and n_i is the number of contracts at risk prior to t_i. This estimator provides the probability that a tender has not yet been awarded by time t_i.

Next, we implement Cox proportional hazards regression models to quantify the impact of tender characteristics, contract types, sectors, and geographic regions on the hazard, or instantaneous probability, of award.

$$\hbar(t|\mathcal{X}) = \hbar_0(t) exp(\beta_1 \mathcal{X}_1 + \beta_2 \mathcal{X}_2 + \ldots + \beta_p \mathcal{X}_p) \tag{5}$$

Where $\hbar(t|\mathcal{X})$ is the instantaneous rate of award at time t given the covariates $\mathcal{X}$, $\hbar_0(t)$ is the baseline hazard function. The hazard ration for a covariate $\mathcal{X}_j$ is $HR_j = exp(\beta_j)$ which measures the multiplicative effect of a one-unit increase in $\mathcal{X}_j$ on the hazard of a tender being awarded.

The Cox model accommodates censored observations, such as tenders not yet awarded, and allows us to control for multiple covariates simultaneously. Hazard ratios greater than one indicate factors associated with faster contract awards, while ratios below one correspond to slower award times. Standard errors and confidence intervals are calculated using the Breslow method to address tied event times, ensuring robust inference. This combination of nonparametric (Kaplan-Maier) and semiparametric (Cox model) survival techniques provides a comprehensive understanding of the dynamics of tender awarding and the influence of policy and institutional factors.

2.6.3 Additional controls

This study seeks to provide a more comprehensive analysis by including tenders that are still open or not yet awarded. Advanced statistical techniques are employed to estimate award durations and provide a more accurate picture of public procurement timelines in Italy.

The variables used in this analysis were selected based on a thorough review of the literature and empirical observations. These variables are organized into four categories, summarised in Table 8. Information on tender characteristics contains main contract object, tender amount, award date, and whether the tender is part of the National Recovery and Resilience Plan (NRRP). Information on geographical location includes the regional section and specific location of the tender. Additionally, socio-economic factors include regional GDP per capita, educational attainment, and demographic composition.

Table 8 – Control variables for econometric analysis

Dimension	Variable	Source	Notes
Tender Characteristics	Main contract object	ANAC	
	Tender amount	ANAC	
	Award date	ANAC	
	NRRP tender	MEF (Italia Domani)	Dummy variable
Quality of Government	European Quality of Government Index	Charron et al. (2024)	
Geographical Location	Region	ANAC	Anac regional section
Socio-Economic Factors	Regional GDP per capita	ARDECO	
	Number of university degrees	ISTAT	
	Population density	ISTAT	

Based on the information collected on the ANAC database, regions can be aggregated at the NUTS 1 level, resulting in five macro-areas representing the geographical distribution of tenders. To this classification, a sixth category is added to account for tenders conducted at the central (national) level rather than the sub-national level. This level of aggregation is motivated by the nature of public procurement processes, as cross-regional dynamics may be present, therefore the level of aggregation accounts for this.

2.6.4 Territorial characteristics of procurement and controls

The geographical distribution, shown in Table 9, shows that procurement volume is greater in the South and North-West areas (respectively with 99,363 and 97,643 contracts), while Islands are the ones with least volume. *Goods* are the most procured type (more than 50% on average), but *Works* are more common in the South (15%) when compared to other regions (10% on average). Lastly, Centralised procurement concentrates on *Services* (47%). A more detailed distribution by region is shown in table A1 in Appendix.

Table 9 – Number of tender by NUTS 1 region

Macro-area (NUTS 1)	Works	Goods	Services	Total
North-West	10,424	50,907	36,312	97,643
North-East	6,676	26,241	25,127	58,044
Centre	6,593	41,551	25,039	73,183
South	15,672	55,234	28,457	99,363
Islands	4,536	32,117	11,892	48,545
Centralised	7,913	21,985	26,742	56,640

Moreover, Table 10 provides statistics on the main socio-economic factors that characterise NUTS-1 regions. As evident from the descriptive statistics, the comparative analysis across GDP per capita (constant prices 2020), educational attainment and population density, macro-areas show a marked North-South divide, with structural characteristics that can be controlled for by using the territorial location.

To facilitate interpretation of the results on the territorial distribution, projects that are in the "*Centralised*" ANAC area are dropped, as they are not specific to local areas and therefore would be pointless in the discussion on the influence of local dimensions influencing award probability and decision period length. Therefore, the dataset is composed of 371,567 tenders.

Table 10 – Description of NUTS 1 characteristics

Macro-area (NUTS 1)	GDP per capita (constant prices 2020)	University degrees (density)	Population density
North-West	37,562	0.102	272.16
North-East	35,450	0.101	183.67
Centre	34,284	0.121	199.72
South	20,358	0.093	189.40
Islands	20,135	0.087	133.03

2.7 Results

Table 11 presents the updated estimates from the Heckman two-step selection model based on 371,567 observations, of which 152,411 pertain to awarded tenders.

Table 11 – Heckman two-stage model

Variables	Coefficient	Std. Error
Outcome Equation (Decision Period)		
Number of bids	0.009	0.015
Award criteria		
Economically Advantageous Offer (Qualitative Criteria Only)	-102.538***	4.080
Economically Advantageous Offer (Lowest Price)	-97.057***	1.081
Economically Advantageous Offer (Best Quality/Price Ratio)	-30.060***	0.999
Lowest Price	-97.008***	1.260
NRRP tender	-28.350***	5.865
EQI (2010-2021 mean)	-37.420***	0.837
NRRP x EQI interaction	40.768***	5.865
Constant	118.313***	1.352
Selection Equation (Probability of Awarded Tender)		
Log amount tendered	0.172***	0.001
Primary object		
Works	0.518***	0.007
Services	-0.051***	0.005
Sector		
Special sector	0.323***	0.009
Geographical area		
North East	0.116***	0.008
Centre	-0.120 ***	0.006
South	-0. 486***	0.006
Islands	-0.372***	0.007
Constant	-2.161***	0.013
Selection Adjustment		
Lambda	65.97***	1.494
Rho	0.430	
Sigma	153.354	
Numb. Of observation	351,739	
Selected	141,211	
Non-selected	210,528	

Robust standard errors
*** p<0.01, ** p<0.05, * p<0.1

The selection adjustment parameters confirm the presence of strong selection dynamics. The inverse Mills ratio ($\lambda = 65.97$) is large and highly significant, indicating substantial selection bias. The estimated correlation between the selection and outcome equations is extremely high ($\rho = 0.430$), signalling that unobserved factors influencing award probability

are strongly correlated with those affecting decision duration. The estimated residual standard deviation (σ = 153.354) reflects the variability in the decision period after correcting for selection.

Overall, these diagnostics reaffirm the necessity of selection correction to obtain unbiased estimates of award duration.

2.7.1 Selection Equation: Determinants of Award Probability

The selection equation continues to show strong and highly significant relationships between tender characteristics and the likelihood of award. Relative to the baseline category (Goods), tenders for Works exhibit a large positive coefficient, indicating a substantially higher probability of award. Services instead show a negative and significant effect, though more moderate in magnitude.

Tenders falling under Special Sectors again display a significantly higher likelihood of award, consistent with the operational and regulatory particularities of these sectors.

Regional patterns remain pronounced. Compared to the North-West, tenders in the North-East are more likely to be awarded. In contrast, tenders in the Centre, South, and Islands show progressively larger negative coefficients, confirming substantial territorial disparities in the conclusion of procurement award procedures.

These findings reiterate that object type, sector, and geography strongly shape the probability that a tender reaches an award decision.

2.7.2 Outcome Equation: Determinants of the Decision Period

The outcome equation models the decision period as a function of several independent variables. Firstly, the logarithm of the amount tendered is not statistically significant at conventional levels, meaning that when adjusted for bias the amount does not influence the decision period. This suggests that larger tenders do not necessarily require more time to adjudicate when compared to smaller ones, at least within the administrative and procedural structure considered here.

By contrast, both the number of admitted bids and the choice of award criteria emerge as significant determinants of award duration. The positive coefficient on the number of bids implies that each additional offer is associated with a longer decision period. Although the effect

is moderate in magnitude, it highlights the procedural complexity arising from more competitive tenders, which require additional evaluation steps and assessment effort.

The award criteria exert particularly strong effects. Relative to the baseline category – tenders without a specified award criterion – all defined criteria substantially reduce the decision period. The *Economically Most Advantageous Offer (qualitative criteria only)* shows the largest negative effect, followed closely by the *Lowest Price under EMOA* and the *Lowest Price* criterion. Even the *Best Quality/Price Ratio* option, while having a smaller magnitude, still significantly accelerates the award process.

These results indicate that tenders governed by clear, predefined evaluation frameworks are resolved considerably faster than those without explicit award rules. The magnitude and consistency of the negative coefficients suggest that transparency and procedural standardization reduce administrative uncertainty and streamline decision-making. This pattern supports the interpretation that procurement authorities can process tenders more efficiently when the evaluation procedure is unambiguous and rule-based, as opposed to situations where award criteria are absent or insufficiently specified.

Furthermore, tenders associated with the National Recovery and Resilience Plan (NRRP) exhibit a significantly shorter decision period, reflecting the priority and accelerated processing granted to strategic projects financed under this program.

Overall, the results show that procedural clarity, competitive structure, and policy pressure play central roles in shaping the duration of public procurement decision-making.

In addition, These results show that the descriptive intuition was indeed correct. To determine whether the effect is a slower or faster award period, we must determine the Marginal Effect of NRRP across the relevant range of the EQI. The estimated effect of an NRRP contract on the duration is now a function of EQI:

$$ME_{NRRP} = \beta_{NRRP} + \beta_{NRRPxEQI} \times EQI$$

The econometric results provide clear evidence that the NRRP is highly effective in increasing the efficiency of public procurement, especially in regions constrained by weak institutional quality. The analysis of the marginal effect confirms that while the NRRP tender status significantly accelerates the Decision Period universally (base coefficient of -28.350 days), the magnitude of this speedup is greatest where the need is most urgent. Specifically, the

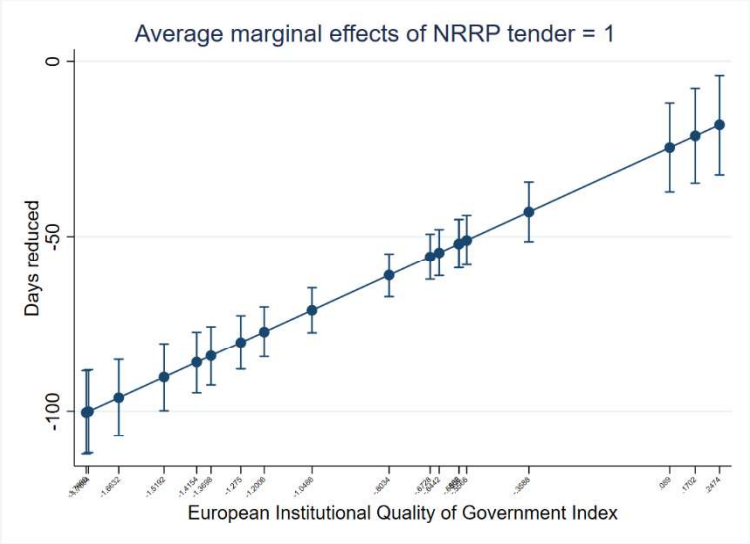
negative effect of the NRRP on duration is most pronounced at the lowest values of the EQI. This result confirms our first Hypothesis, that the NRRP decreased award periods, and contributes to answer to our second Hypothesis (that institutional quality moderates whether pressure leads to acceleration override), finding that the bureaucratic friction and slower awarding typical of low-EQI environments are overcome by the P*olicy Pressure*. In essence, the program's importance functions as a potent institutional substitute, providing the largest proportionate efficiency gains to the weakest-governed regions, thereby contributing to the mitigation of long-standing regional institutional disparities.

Moreover, the analysis of the conditional marginal effects provides a precise understanding of how the NRRP program's effectiveness varies with institutional quality, presented in Table A1 in Appendix.

The primary finding is that the NRRP tender status leads to a statistically significant reduction in the Decision Period (dy/dx is negative) across the entire observed distribution of institutional quality. Crucially, the magnitude of this speedup exhibits diminishing returns as the EQI increases. The Marginal Effect (dy/dx) decreases monotonically from a maximum absolute reduction of -100.37 days in the lowest-EQI regions to a minimum absolute reduction of -18.26 days in the highest-EQI regions.

A more intuitive representation, presented in the marginal effects plot in Figure 2, shows the effect of the NRRP on the decision period is significant and negative (faster) across the entire observed range of the EQI, but it exhibits a clear pattern of *diminishing returns*. Specifically, in regions with the lowest institutional quality (EQI ≈ -1.77), the NRRP contract reduces the award period by approximately 100 units. This dramatic speedup is essential, as the Mean Decision Period graph (Figure 1) illustrates that non-NRRP tenders in these regions are the most protracted, frequently exceeding 200 days. Conversely, as institutional quality improves toward the maximum observed EQI (≈ 0.25), the speedup benefit diminishes to approximately 20 units. This strong inverse relationship confirms that the NRRP's streamlined procedures function as an effective institutional substitute, providing the most substantial proportional efficiency gains to the regions historically plagued by the longest delays and weakest governance.

Figure 4 – Average marginal effect of NRRP tender = 1 with 95% C.I.



The analysis robustly confirms that *Policy Pressure*, through the National Recovery and Resilience Plan (NRRP), has successfully accelerated the award period for public contracts, validating the hypothesis that the program decreased overall procurement duration (H1). Crucially, the evidence on the conditional marginal effects demonstrates that the policy's effectiveness is strongly moderated by regional institutional quality, addressing the second hypothesis (H2) by showing that policy pressure effectively overrides administrative friction. While NRRP contracts are significantly faster across all regions, the program's benefit is characterized by *diminishing returns to institutional quality*. This is vividly demonstrated by the speedup magnitude decreasing monotonically from approximately 100 days in the lowest-EQI regions to just 20 days in the highest-EQI regions. This strong inverse relationship confirms that the NRRP's priority, providing the most substantial proportional efficiency gains to the weakest-governed entities. Consequently, the program plays a vital role in mitigating the chronic regional disparities in public spending efficiency and project execution by setting a high-efficiency standard regardless of local institutional quality.

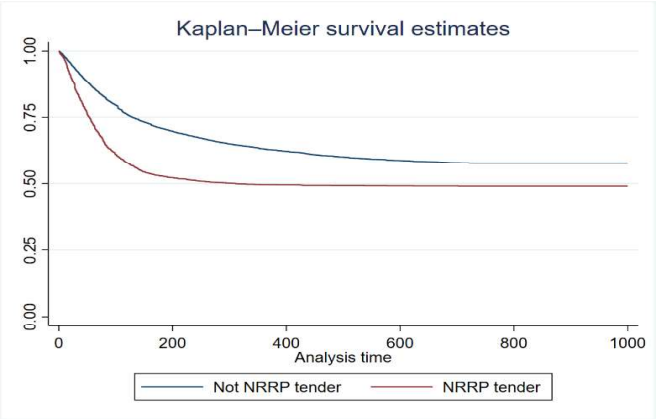
2.7.3 Survival Analysis

To complement the Heckman estimates and provide a dynamic assessment of award timing, we implement survival analysis techniques, combining nonparametric Kaplan–Meier estimators with semiparametric Cox proportional hazards regression. This approach allows us to model

both the probability and the timing of tender awards while appropriately handling right-censoring, which is pervasive in procurement data.

Figure 5 presents Kaplan–Meier survival curves for NRRP-related and non-NRRP tenders. The curves diverge early in the process and remain separated throughout the observation window. By approximately 300 days after the submission deadline, around 50% of NRRP tenders had been awarded, compared with only about 35% of non-NRRP tenders. The log-rank test rejects equality of the two survival functions at conventional significance levels, indicating that NRRP tenders experience systematically faster award processes. This descriptive evidence aligns with the institutional objective of accelerating the implementation of NRRP-funded projects.

Figure 5 – Kaplan-Meier survival estimates by NRRP tender



Territorial heterogeneity also plays a substantial role in shaping award timing. Figure 4 reports Kaplan–Meier curves by NUTS-1 macro-areas. The survival functions reveal a pronounced North–South divide: approximately 50% of tenders in the North-East are awarded within 300 days, compared with roughly 43% in the North-West, 35% in the Centre, 25% in the South, and 24% in the Islands. These differences are statistically confirmed through log-rank tests, which reject the hypothesis of homogeneous survival functions across regions. The magnitude of these disparities signals persistent structural differences in administrative performance across Italian territories.

Three main patterns emerge. First, there is substantial geographic heterogeneity in procurement duration. Tenders in the North-East exhibit the fastest resolution: their survival curve lies uniformly below those of all other macro-regions, indicating that the probability of remaining unresolved at any given point in time is consistently lower. The North-West also displays relatively rapid completion, though its curve lies slightly above the North-East. By

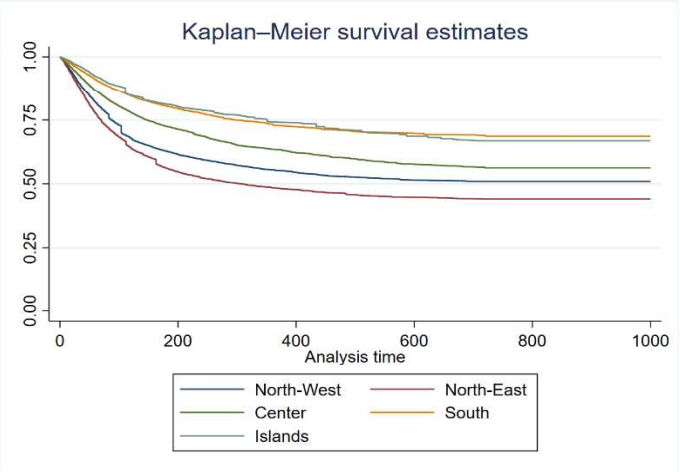
contrast, tenders in the South and Insular regions show markedly slower processing. Their survival curves are persistently higher, implying longer expected durations and a slower decline in the probability of remaining unresolved. The central regions lie in an intermediate position.

Second, the initial hazard is steep across all regions, with a large fraction of tenders being resolved within the first few months. However, the regional gaps appear early and persist throughout the distribution. This suggests that regional disparities are not driven solely by a small number of extremely delayed procedures, but rather reflect systematic differences in the speed of administrative processing.

Third, the curves flatten after roughly 1,000 days, indicating that beyond this horizon unresolved tenders represent a relatively small and increasingly selected set. The persistent differences across regions at these longer durations suggest that institutional frictions or Institutional Quality constraints may disproportionately affect slow-moving procedures.

Taken together, the survival estimates document large and persistent territorial disparities in procurement efficiency. Regions with weaker Institutional Quality or lower institutional quality appear significantly less able to process tenders promptly. These results are consistent with the broader literature emphasizing the role of state capacity and bureaucratic effectiveness in shaping public sector performance and implementation efficiency.

Figure 6 – Kaplan–Meier curves by NUTS-1 macro-areas



To account for multiple covariates simultaneously and isolate the determinants of award timing, we estimate a Cox proportional hazards model. Results are reported in Table 12. Consistent with the Kaplan–Meier evidence, NRRP tenders exhibit a significantly higher hazard of award, with an estimated hazard ratio of 1.49. This implies that, holding all other covariates

constant, NRRP tenders are awarded approximately 49% faster than comparable non-NRRP tenders. This result is robust and suggests a meaningful policy effect associated with the prioritization of NRRP procedures.

Other covariates also display substantive and statistically significant effects. Tenders for construction and services contracts have hazards more than twice as large as those for goods, suggesting that these categories progress more quickly through the award process—possibly due to stronger administrative incentives. Special-sector tenders also exhibit a faster award dynamic, reflected in a hazard ratio of 1.36.

Regional effects confirm the descriptive patterns: compared with the North-West baseline, tenders in the Centre, South and Islands have substantially lower hazards (0.75, 0.70, and 0.68 respectively), indicating markedly slower award processes. In contrast, the North-East displays a slightly higher hazard, consistent with its relatively stronger administrative performance. These findings underscore the persistence of territorial inequalities in procurement efficiency.

The number of admitted offers has a small and statistically insignificant effect in the Cox model, suggesting that, conditional on other characteristics, competition intensity has limited influence on the timing of awards. This contrasts with the Heckman estimates, where the coefficient is significant, highlighting the value of using alternative empirical strategies to validate the robustness of the results.

Table 12 – Cox Proportional Hazards Regression: Time to Tender Award

Variable	Hazard Ratio	Std. Err.	z
Number of Admitted Offers	1.00008	0.00010	0.74
NRRP Tender	1.49141***	0.02969	20.08
Contract Type			
Construction	2.25357***	0.01777	103.06
Services	2.29315***	0.01363	139.59
Sector			
Special Sectors	1.35785***	0.01291	32.18
Geographic Area			
North-East	1.02198***	0.00739	3.00
Center	0.74655***	0.00546	-39.98
South	0.70125***	0.00518	-48.02
Islands	0.68013***	0.00633	-41.43

Notes:
- Hazard ratios above 1 indicate faster time to award.
- Reference categories: Contract Type = “Goods”, Sector = “Ordinary”, Geographic Area = North-West.
- Standard errors and confidence intervals calculated using the Breslow method for ties.
- Significance levels: p<0.01, ** p<0.05, * p<0.1

Taken together, the Kaplan–Meier estimates and Cox model provide consistent evidence that NRRP tenders are processed more rapidly than non-NRRP tenders, both unconditionally and when adjusting for contract type, sectoral classification, competition, and geographical location. This accelerated processing likely reflects institutional prioritization and procedural streamlining associated with the NRRP framework. At the same time, the pronounced regional disparities highlight enduring administrative asymmetries that persist despite national-level reforms. These findings reinforce the importance of accounting for both policy-induced heterogeneity and territorial capacity constraints in analyses of procurement efficiency.

2.8 Robustness checks

To ensure that the empirical findings are not driven by data truncation issues inherent in the most recent reporting periods, I conduct a robustness check by excluding the 2023 cohort from the sample, reported in Table 13. This exclusion is motivated by the systematic reporting lags typical of public procurement databases, where the high frequency of missing award dates in 2023 might introduce a "survivorship bias" – wherein only exceptionally efficient or simple tenders are recorded as completed, potentially distorting the observed relationship between

institutional quality and administrative speed. The results of the Heckman two-step selection model on this restricted sample provide compelling evidence for the stability of the primary hypothesis. The coefficient for institutional quality remains negative and highly significant for the baseline group, confirming that under standard procurement regimes, weak local institutions impose a substantial "time tax" on the award process. Crucially, the interaction term for NRRP tenders is positive, large, and statistically significant. This indicates that the NRRP framework effectively "decouples" the duration of the award process from the underlying institutional capacity of the region where the tender is located. In the standard regime, a one-unit increase in institutional quality reduces award time by approximately 47 days, whereas for NRRP tenders, this marginal benefit is attenuated to roughly 10 days. This finding suggests that the simplified procedures and heightened monitoring associated with the NRRP act as a procedural equalizer, shielding the procurement process from the inefficiencies typically associated with low-quality institutions. Furthermore, the significance of the Inverse Mills Ratio validates the use of the selection model, confirming that the factors governing the likelihood of a tender being awarded are non-randomly associated with the factors determining its speed. By demonstrating that these effects persist even when the most volatile data year is removed, the analysis strengthens the claim that the *Policy Pressure* brought about by the NRRP is a structural driver of efficiency rather than a temporal artifact of reporting cycles.

Table 13 – Heckman two-stage model without tenders published in 2023

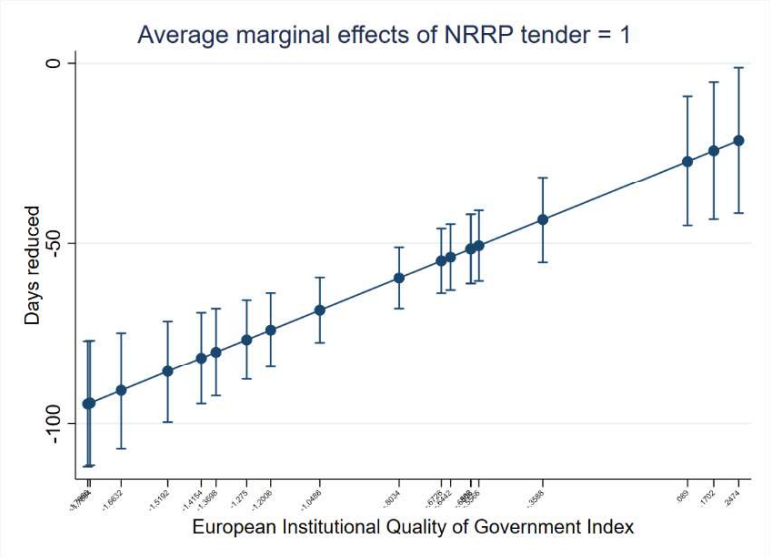
Variables	Coefficient	Std. Error
Outcome Equation (Decision Period)		
Number of bids	-0.086***	0.015
Award criteria		
Economically Advantageous Offer (Qualitative Criteria Only)	-94.950***	4.491
Economically Advantageous Offer (Lowest Price)	-90.285***	1.133
Economically Advantageous Offer (Best Quality/Price Ratio)	-20.999***	1.045
Lowest Price	-96.588***	1.286
NRRP tender	-30.424***	8.456
EQI (2010-2021 mean)	-46.868***	0.850
NRRP x EQI interaction	36.341***	8.536
Constant	139.227***	1.244
Selection Equation (Probability of Awarded Tender)		
Log amount tendered	0.212***	0.001
Primary object		
Works	0.477***	0.008
Services	-0.173***	0.005
Sector		
Special sector	0.309***	0.010
Geographical area		
North East	0.610***	0.008
Centre	-0.137 ***	0.007
South	-0. 548***	0.006
Islands	-0.473***	0.008
Constant	-2.409***	0.014
Selection Adjustment		
Lambda	36.05***	1.430
Rho	0.240	
Sigma	149.838	
Numb. Of observation	298,170	
Selected	133,149	
Non-selected	165,021	

Robust standard errors *** p<0.01, ** p<0.05, * p<0.1

Moreover, the analysis of average marginal effects (Figure 6) further elucidates this relationship and provides robust support for Hypothesis 2, which posits that the NRRP's streamlining effects are most pronounced in institutional environments characterized by low institutional quality. As shown in the marginal effects decomposition, the "speed-up" effect of the NRRP is monotonically decreasing in institutional quality. In the most institutionally challenged jurisdictions, the NRRP status is associated with a drastic reduction in award duration of approximately 94.6 days. This efficiency gain remains substantial but narrows significantly as institutional quality improves, falling to 50.6 days at the sample mean and reaching its minimum

of 21.4 days in the highest-quality institutional environments. These results suggest that the *Policy Pressure* induced by the NRRP's urgency acted as a "procedural equalizer". In fact, the results suggest that the NRRP effectively shields the procurement process from the inefficiencies typically associated with low-quality local administrations, thereby narrowing the performance gap between the most and least efficient regions. The persistence of these heterogeneous effects after the removal of 2023 data confirms the *Policy Pressure*'s ability to mitigate institutional weakness is a structural feature of the policy framework rather than an artifact of data reporting cycles.

Figure 6 – Average marginal effect of NRRP tender = 1 with 95% C.I. without tenders from 2023



2.9 Conclusions

This study addresses a critical yet under-researched aspect of public procurement: the impact of crisis-driven Policy Pressure on award-decision speed, and whether its effects vary across territories with differing institutional quality. By analysing the universe of Italian above-threshold open-procedure tenders from 2016–2023, we tested a capacity-moderated model using complementary Heckman two-stage and survival analysis frameworks. The results provide robust evidence supporting both hypotheses.

Policy Pressure from the NRRP significantly accelerated procurement awards, confirming H1. NRRP tenders exhibited a roughly 28–30 day shorter award duration compared to non-NRRP tenders, with Kaplan–Meier estimates revealing a median time-to-award of 309 days for NRRP procedures versus unresolved medians for others within the observation window. Cox proportional hazards models further indicate a 28% higher hazard of award for NRRP tenders, controlling for contract type, sector, competition, and regional factors. These gains align with theoretical expectations that urgency prompts procedural simplification, routine adaptation, and managerial reallocation (Grandia & Warsen, 2023), enabling faster mobilisation under crisis conditions.

However, acceleration proved uneven, validating H2. Institutional Quality – proxied by the European Quality of Government Index – exhibits diminishing returns: the speedup effect is strongest in low-quality regions (up to 100 days faster) and weakens monotonically in higher-quality areas (down to ~20 days). Regional survival curves underscore persistent North-South divides, with northern tenders resolving far quicker than those in the Centre, South, and Islands. The positive NRRP coefficient paired with a significant positive interaction term in the Heckman model reveals this moderation: while Policy Pressure acts as an "institutional substitute" by delivering outsized gains to weaker administrations, structural capacity gaps limit convergence.

These findings fill key literature gaps by providing evidence on crisis acceleration (extending He et al., 2023; Glas et al., 2025) and documenting territorial heterogeneity in a high-stakes context like Italy's NRRP (one of the largest spending programs in decades with more than €190 billion in allocation). They challenge simplistic views of timeliness as mere efficiency, reframing it as a governance outcome shaped by pressure and capacity.

For policy, results highlight the value of targeted simplifications in emergencies but warn against over-reliance without capacity-building. NRRP-like frameworks narrowed disparities by boosting lowest quality regions the most, yet gaps endure – suggesting complementary investments in bureaucratic training, digital tools, and regional equalization (e.g., via ANAC oversight). Future research could extend this to post-award execution, cross-national NGEU comparisons, or experimental designs testing simplification thresholds.

Furthermore, acknowledging the distinction between structural institutions and organizational capability opens critical avenues for future research. Because the regional institutional quality metric aggregates the performance of a heterogeneous multiplicity of public bodies, the exact transmission mechanism of Policy Pressure remains partially obscured. Future empirical strategies should disaggregate procurement data by the specific type of contracting authority – for instance, isolating municipalities from regional health agencies (ASLs) or central administrative branches. Such disaggregation will be essential to accurately isolate the role of pure administrative capacity (and temporary resource shocks, such as the hiring of PNRR experts) from the broader, more static institutional framework.

Notes

[1] https://single-market-economy.ec.europa.eu/single-market/public-procurement_en

[2] The Italian National Recovery and Resilience Plan (NRRP, *Piano Nazionale di Ripresa e Resilienza*, PNRR) has been revised in June 2024 and is now articulated into seven Missions: (1) Digitalisation, innovation, competitiveness, culture and tourism; (2) Green revolution and ecological transition; (3) Infrastructure for sustainable mobility; (4) Education and research; (5) Inclusion and cohesion; (6) Health; and (7) RepowerEU, focusing on energy diversification and security. The first six were already part of the plan before the revision.

[3] The European Quality of Government Index (EQI), developed by Nicholas Charron and colleagues, measures subnational quality of government across EU regions. It captures a latent, multidimensional concept centred on three pillars: impartiality (equal treatment regardless of personal connections), low corruption (no public abuse for private gain), and high quality/effectiveness of public services. It relies on citizen surveys assessing perceptions of public services like health and education, plus experiences with petty corruption; scores are standardized z-scores with the EU average at zero.

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Appendix A

Table A1 – Marginal Effect of NRRP by European Quality of Government Index

Institutional Quality (EQI group)	dy/dx (Marginal Effect of NRRP)	Std. Error	Interpretation
1	-100.371***	6.09	Maximum Speedup (dy/dx) with lowest EQI
2	-100.078***	6.05	
3	-96.156***	5.57	
4	-90.285***	4.89	High Speedup
5	-86.053***	4.44	
6	-84.194***	4.25	
7	-80.329***	3.89	
8	-77.296***	3.64	
9	-71.099***	3.26	Median Speedup (dy/dx) with median EQI
10	-61.103***	3.11	
11	-55.779***	3.30	
12	-54.613***	3.36	
13	-52.077***	3.52	
14	-52.020***	3.53	
15	-51.041***	3.60	
16	-42.977***	4.31	Moderate Speedup
17	-24.721***	6.42	
18	-21.411***	6.85	
19	-18.264***	7.25	Minimum Speedup (dy/dx) with highest EQI

Which Governance for an Inclusive Transition? Territorial Distribution of Cohesion Policy and NGEU Funding

Giacomo Gazzellone

Abstract

This paper examines how policy implementation choices shape territorial inclusiveness in innovation-led transition policies. It introduces project-level *modes of governance*—the procedural, organisational, and relational configurations structuring project design, coordination, and delivery—as a key lens to analyse participation across territories. Exploiting the coexistence of two contrasting implementation frameworks, the decentralised Smart Specialisation Strategies (S3) and the centralised National Recovery and Resilience Plan (NRRP), we assess which approaches and *modes of governance* enhance inclusiveness. Using project-level microdata for Italian municipalities, we combine multinomial logit models and machine-learning algorithms to identify the *modes of governance* enabling municipalities unlikely to participate ex ante to access funding. We find persistent territorial exclusion across both policies, favouring wealthier and urban areas, while the NRRP significantly increases participation in peripheral regions. Inclusiveness depends not on implementation frameworks alone, but on specific governance configurations—particularly centralised leadership, streamlined project design, and public–private cooperation. These findings show how institutional architecture shapes the territorial reach of transition policies and inform the design of post-2027 Cohesion Policy.

Keyworkds: Territorial inclusiveness, modes of governance, National Recovery and Resilience Plan, Smart Specialisation Strategy

JEL Classification: R58, H77, O18

3.1 Introduction

Ensuring the success of the twin transition requires the European Union (EU) Cohesion Policy (CP) to strengthen the innovation capacity of all regions through their effective inclusion in transition-oriented strategies. Otherwise such dynamics risk further widening territorial disparities (Capello and Rodriguez-Pose, 2025; Rodríguez-Pose and Bartalucci, 2024). Over time, innovation objectives within EU policies have been consistently pursued through Cohesion Policy, albeit under different governance frameworks. These include top-down frameworks, in which the central state retains primary authority and implementation is not shaped by regional discretion, and bottom-up frameworks, where subnational bodies and territorial actors design and implement development strategies autonomously, without direct central government intervention (Fratesi, 2023). More recently, innovation objectives have been advanced through two major initiatives—Smart Specialisation Strategies (S3) and, in response to the Covid-19 crisis, Next Generation EU (NGEU)—which embody contrasting approaches to policy implementation (Filippetti and Spallone, 2025; Polverari, 2025). While S3 builds on a bottom-up, place-based logic centred on local ownership and context sensitivity (Barca, 2009; Barca et al., 2012), it has often struggled with limited efficiency and scale, particularly in weaker regions (Farole et al., 2011; McCann and Ortega-Argilés, 2015). By contrast, NGEU represents a shift towards a top-down, centralised and mission-oriented framework, prioritising strategic coordination and rapid implementation, potentially at the cost of reduced local involvement and place sensitivity (Darvas, 2020; Mazzucato, 2018; Hervás-Oliver et al., 2021). These differences in implementation frameworks can have important implications for participation and territorial inclusiveness. In this paper, participation refers to the observable involvement of municipalities in policy instruments, while inclusiveness is understood more substantively as the capacity of policy frameworks and governance arrangements to enable the participation of municipalities that would otherwise be unlikely to engage, given their structural territorial, socio-economic, and administrative conditions. While a substantial literature has examined the relative performance of alternative implementation frameworks (e.g. (Crescenzi and Giua, 2016; Weck et al., 2021; Mazzucato, 2018), it offers limited insight into how these approaches shape inclusive territorial participation—a question that has rarely been addressed explicitly (e.g., (Santos and Conte, 2024)). In this context, the introduction of NGEU, as the first large-scale example of a fully mission-oriented and centrally coordinated implementation framework in EU regional

policy, reopens this debate and provides a unique opportunity to reassess it beyond a simple comparison between top–down and bottom–up approaches. Indeed, an emerging strand of the literature argues for moving beyond this rigid dichotomy and towards more context-sensitive and integrated policy mixes, in which centrally coordinated and redistributive mechanisms complement place-based knowledge and stakeholder engagement (Crescenzi and Giua, 2020; Di Caro and Fratesi, 2022; Fiaschi et al., 2018; Gagliardi and Percoco, 2017). Against this backdrop, understanding the mechanisms behind territorial inclusiveness requires shifting attention from high-level implementation paradigms to the concrete governance arrangements through which policies are operationalised on the ground. While recent contributions have begun to examine the role of specific governance configurations in shaping policy implementation and participation (Crescenzi et al., 2021; Del Monte et al., 2022), a systematic conceptualisation and a clearer understanding of their implications for territorial inclusiveness have so far been lacking. This paper advances the debate by conceptually formalising the concept of *modes of governance* and analysing their role within a unified analytical framework. We define *modes of governance* as the procedural, organisational and relational configurations that structure project design, coordination and delivery.

Taken together, this points to a critical gap in current EU policy debates, calling for a shift beyond abstract comparisons between bottom–up and top–down approaches towards an examination of how concrete governance arrangements shape territorial participation and inclusiveness in practice. Against this background, this paper addresses two interrelated research questions: (i) which implementation framework — place-based or mission-oriented — more effectively fosters territorial participation in innovation-led transition policies? and (ii) through which project-level *modes of governance* are municipalities enabled to participate in such policies, particularly when structural, socio-economic, and administrative conditions would otherwise constrain their access?

This paper addresses these questions by exploiting the coexistence of two major EU initiatives in Italy — the decentralised S3 (within the Cohesion Policy 2014-2020 programming period) and the centralised NGEU funded through the Recovery and Resilience Facility (RRF) between 2021 and 2026 — to assess which governance configurations are more effective in fostering inclusiveness.

Particularly, the analysis is twofold. First, to identify whether alternative implementation regimes mitigate or reinforce territorial asymmetries in the distribution of policies support, we leverage a

multinomial logit model regression estimates the probability of participation in each implementation framework — the centralised NRRP and the place-based S3 — as a function of terriorial, socio-economic, and administrative characteristics. Second, we identify municipalities that have received funding from either policy that share territorial, demographic and economic characteristics against those that did not receive any funding. Then we apply Machine Learning (ML) algorithms (Random Forest, Elastic Net, Support Vector Machine and Gradient Boosting Machine) to uncover which *modes of governance* predict the participation of municipalities that would have not participated (i.e. inclusiveness). The use of machine learning (ML), still under utilised in the study of EU CP and NRRP implementation, enhances the analysis by capturing non-linear and high-dimensional relationships that traditional methods may overlook (Chernozhukov et al., 2022). Then we use SHapley Additive exPlanation (SHAP) values to reveal how each *mode of governance* influences inclusiveness. The algorithms are applied on a project-municipality level, assessing how project scale and design affect participation of actors in municipalities that ex-ante were not likely to participate. In particular, the analysis focuses on Italian municipalities, which provides a particularly compelling case study because of well established territorial, economic and administrative constraints (Viesti, 2021; De Philippis et al., 2022; Cerqua et al., 2025).

This analysis is particularly relevant in the current policy context, as the governance models and implementation mechanisms tested through S3 and the NRRP anticipate key design challenges of the post-2027 Cohesion Policy framework. The forthcoming programming period is expected to consolidate a mission-oriented, performance-based and time-sensitive approach inspired by the logic of NGEU (Coletti and Filippetti, 2025). Ensuring that innovation-led transitions are both effective and territorially inclusive is therefore no longer merely a matter of administrative efficiency, but a strategic priority for the EU, especially as failure to broaden territorial participation risks widening the gap between core and more fragile areas.

Accordingly, this paper examines for the first time how institutional design shapes territorial inclusiveness across different implementation frameworks in innovation-led transition policies. It introduces and systematically conceptualises project-level *modes of governance* as a key analytical lens to understand how participation is enabled across territories, contributing to the literature on policy implementation frameworks, multilevel governance and innovation-driven regional development. The paper also offers policy-relevant insights for the design of future EU funding mechanisms, particularly with respect to balancing efficiency, accountability and

territorial inclusiveness. To our knowledge, this is the first empirical comparison of S3 and the NRRP at the municipal level, combining matched data and machine learning methods to identify governance configurations associated with inclusive participation.

Our results reveal a persistent geography of exclusion: wealthier, more urban, and entrepreneurial municipalities are significantly more likely to access funding from both policies. Yet, the top-down NRRP shows greater capacity to reach Less Developed and Peripheral areas, partly offsetting territorial disadvantages. Machine-learning results confirm that *inclusiveness* is not determined by centralisation alone, but by specific *modes of governance*. Project designs that streamline decision-making, centralise leadership, or foster public–private collaboration are consistently associated with more inclusive participation.

3.2 Governance and Territorial Inclusiveness

The notion of policy *inclusiveness* is frequently invoked in regional development and innovation studies, yet it remains theoretically questioned (Benner et al., 2024; Casadella, 2025; Morales, 2025), especially in debates concerning "left-behind places" (Dijkstra, 2024; Pike et al., 2025). Such analysis matter for policy implementation, because they shape how inclusiveness is translated into concrete objectives and criteria. In the context of the EU, inclusiveness constitutes a fundamental challenge in the design of transition-oriented policies aimed at ensuring that no territory is left behind. Policy frameworks often operationalise the participation of territories into policies through the spatial dispersion of applications or the diversity of beneficiaries(EU Commission, 2017), but such indicators capture only the potential — not the realisation — of participation overlooking the *modes of governance* through which local actors are able to engage with and access funding. This distinction is particularly salient for municipalities located in more fragile and remote contexts (e.g., less developed regions, rural areas, and peripheral territories) where structural disadvantages such as weaker administrative and absorptive capacity, lower human capital and digital skills, and path-dependent specialisation in lower-productivity sectors tend to cumulate (Diodato et al., 2023; Bănică et al., 2024). These constraints are compounded by limited access to inter-institutional networks, partnerships and knowledge flows (Kovacic et al., 2024), making it difficult for local actors to identify, apply for, and manage transition-related investments. As a result, the territories most in need of transformation are often the least able to engage with transition-oriented opportunities (Capello and Rodriguez-Pose, 2025), with

R&D spending and innovation benefits remaining concentrated in already strong and attractive areas (Muringani et al., 2024; Celli et al., 2024).

To capture these dynamics, we follow Santos and Conte (2024) and adopt an outcome-oriented definition of inclusiveness, understood as the actual ability of local actors to secure funding and participate meaningfully in policy implementation. This outcome-oriented and project-based focus allow to study the importance of policy design and territorial governance arrangements in shaping participation, providing a useful lens through which to examine the inclusive dimension of recent EU transition-oriented policies.

We fisrt focus on two broad approaches. S3, at the heart of the 2014–2020 CP, is the innovation policy reflecting the broader shift toward a place-based policy framework inspired by the Barca Report, which emphasises territorial specificities, local knowledge and context-sensitive interventions (Barca, 2009). In this spirit, S3 embodies a bottom-up, place-based approach centred on "entrepreneurial discovery process" (EDP), a participatory process through which firms, universities, intermediaries and local stakeholders collectively identify a territory's most promising domains of specialisation and guide investment priorities (Foray, 2016; Foray et al., 2018). Through this mechanism, S3 aimed to align innovation strategies with locally embedded capabilities and development opportunities, fully operationalising the principles of the place-based paradigm within the Cohesion Policy programming period. Extensive research highlights persistent implementation challenges — such as weak prioritisation, administrative overload, and strategic imitation — particularly in lagging regions with limited institutional capacity (McCann and Ortega-Argilés, 2015; Capello and Kroll, 2018; Iacobucci and Guzzini, 2016; Papamichail et al., 2023; Di Cataldo et al., 2022). Empirical findings on the economic and innovation impacts of S3 also remain mixed: while some studies identify positive effects on investment and employment in less developed regions (Foglia, 2025), others find no significant impact on firm-level performance in earlier S3 programmes (Crescenzi et al., 2020).

In 2021, in response to the Covid-19 pandemic, the EU funded a recovery program, the Next Generation EU (NGEU), designed and agreed with national governments, that implemented it trough National Recovery and Resilience Plans. The NGEU approaches innovation targets by adopting a top-down, mission-oriented governance framework, therefore prioritising innovation and transition-related investment through centralised coordination. Although still in implementation, a growing body of emerging research has begun to assess its design and spatial effects — for instance, on regional economies under NGEU (Almazán-Gómez et al., 2025), on the distribu-

tion of R&I funds (Santos and Conte, 2024), and on climate-related investments (D'Angeli and Gazzellone, 2025). However, notwithstanding the ambitious objectives of the NRRP, scholarly attention has so far focused primarily on its allocation and economic effects, leaving the analysis of its governance architecture and implications for territorial inclusiveness unexplored, with the exception of Mascioli and Leek (2025), that examine spatial and temporal effects on how Italian municipalities secure and implement NRRP projects. It analyzes factors enabling local communities to initiate development projects, finding that project incidence correlates positively with neighboring municipalities' projects (spatial effects) and past CP projects from 2014–2020 (temporal effects), moderated by local administrative capacity.

More generally, academic and policy debates have long centred on the contrast between the two implementation paradigms, framing the design of regional development and innovation policies around the opposition between top–down models and bottom–up approaches. In the context of CP, recent contributions show that the implications of this dichotomy are nuanced. Top–down, centralised architectures are typically associated with stronger strategic coherence, clearer directionality and an enhanced capacity to accelerate implementation through central coordination (Crescenzi et al., 2020; Mazzucato, 2018). Empirically, they have been shown to perform comparatively better in institutionally weak regions, where local capacity constraints and coordination failures hinder effective bottom–up action (Crescenzi and Giua, 2020; Weck et al., 2021). However, their hierarchical design may also overlook local needs and risk marginalising actors with weaker administrative or absorptive capacity (Hervás-Oliver et al., 2021).

Conversely, bottom–up, place-based frameworks emphasise stakeholder engagement, territorial embeddedness and local knowledge (Barca, 2009; McCann and Ortega-Argilés, 2016). Their proposed strength lies in the ability to identify needs and opportunities that are not visible from the centre and to mobilise endogenous development potential (Mendez et al., 2021). However, several studies caution that place-based strategies often struggle where local capacities are limited, leading to coordination challenges, weak prioritisation, policy imitation and delays (Crescenzi and Giua, 2016; Semeraro et al., 2020). In the absence of adequate redistributive instruments—such as territorial earmarking, capacity-building measures, or compensatory funding rules—and multi-level governance support, bottom–up approaches alone may even risk reinforcing spatial inequalities (Avdikos and Chardas, 2016).

Taken together, this evidence suggests that the effectiveness of different approaches is shaped by the territorial contexts in which they are deployed, yet their implications for territorial inclu-

siveness remain unexplored. This gap points to the need to move beyond broad implementation paradigms and examine the role of policy choices that translate into concrete governance arrangements at the project level. In this paper, we focus on the procedural, organisational and relational configurations that structure project design, coordination and delivery. Despite their relevance for shaping territorial inclusiveness, the role of these project-level choices, both within top-down or bottom-up frameworks, have received limited systematic attention with predominantly descriptive contributions to date (e.g., (Crescenzi et al., 2021; Del Monte et al., 2022). However, prior contributions indicate that project-level governance configurations can play a role in shaping territorial inclusiveness and participation outcomes.

First, *Programmers* shape coordination capacity, authority, and alignment with territorial needs. Multi-level governance research shows that different arrangements condition implementation dynamics across policy levels (Hooghe, 1996), while empirical evidence indicates that centralised leadership may enhance coherence and timeliness, and decentralised leadership may strengthen territorial embeddedness but hinder absorption in weaker institutional contexts (Crescenzi et al., 2021; Del Monte et al., 2022; **?**).

Second, choices on how to select and involve *beneficiaries* can influence territorial inclusiveness by determining who can effectively access programmes and implement projects. Reflecting the multilevel and cross-sectoral nature of Cohesion Policy, *beneficiaries* range from central ministries and regional agencies to municipalities, universities, firms, and civil society organisations. Across public and private beneficiaries administrative capacity, regulatory expertise, and strategic planning abilities differ substantially, with particularly binding constraints for local public actors (OECD, 2025). Additionally, while choosing to promote public–private configurations can pool complementary resources and expertise, they typically involve higher coordination and transaction costs, which may condition participation and delivery outcomes (Hodge and Greve, 2017).

Third, the mechanisms selected to activate projects shape participation by structuring entry conditions and administrative complexity. Negotiated and participatory procedures aim to align policy supply and demand through stakeholder engagement (Foray et al., 2011). By contrast, competitive calls prioritise implementation capacity but may systematically favour actors embedded in structurally advantaged territories, thereby limiting access for weaker beneficiaries (Barca, 2009; Caravaggio et al., 2025a). In practical terms, open calls may broaden formal access but tend to favour actors with higher administrative capacity, while targeted instruments can

accelerate delivery at the cost of restricting participation to selected actors or territories (OECD, 2025). From an inclusiveness perspective, these choices shape participation by generating different types of entry barriers and administrative burdens.

Fourth, including the involvement of multiple beneficiaries and territories, are a defining feature of Cohesion Policy and are often justified by their potential to foster collaboration, knowledge exchange, and innovation. At the same time, project-level complexity substantially increases coordination and administrative costs, particularly when multiple actors operate across different jurisdictions, with negative implications for implementation timelines and outcomes (Dąbrowski, 2014; Carley and Christie, 2017). Empirical evidence further suggests that collaborative interventions involving multiple beneficiaries may fail to generate economies of scale and can even be associated with weaker investment and employment effects (Crescenzi et al., 2020).

Taken together, this evidence suggests that the capacity of local actors to access funds depends not only on top-down or bottom-up implementation frameworks, but also on project-level choices in terms of governance arrangements. Yet the literature has not explicitly analysed how these shape the participation of structurally weaker territories. By addressing this gap, this paper leverages S3 and the NRRP as a testbed to assess the implications of implementation frameworks (bottom-up and top-down) and governance arrangement choices at the project level for territorial participation and inclusiveness.

3.3 Data and descriptive statistics

As evidenced in the literature review, S3 and NRRP have common objectives while having different implementation frameworks. To understand the impact of this difference on participation this study concentrates on Italy, as it provides a suitable empirical setting in light of its territorial, economic and administrative disparities (Viesti, 2021; De Philippis et al., 2022; Cerqua et al., 2025), while also providing freely available project level data on different stages of the implementation process. In particular, project level open-data are provided for the two policies on different platforms: (1) *Opencoesione* for S3 projects, managed by the Department for cohesion policies and the south, it provides comprehensive datasets on projects funded by Cohesion Policy instruments; and (2) *Italia Domani* for NRRP projects, managed by the Ministry of Economy and Finance, it provides detailed information on the entirety of the Italian

NRRP. Both sources provide more than 200 project-level variables, including project objectives, categories, economic sectors, locations, participating entities, and activation procedures. Within these variables we identify some key procedural, organisational and relational configurations that structure project design, coordination and delivery, that we define as *modes of governance*.

Our *Modes of Governance* build on the framework proposed by Crescenzi et al. (2021) and are grouped across four analytical areas: *Leadership*, *Beneficiary*, *Activation*, and *Complexity*. Additional controls capturing *Project Profile* and *Context* account for structural heterogeneity across projects. Table B1 in Appendix B provides a detailed description of all variables, including description and frequency.

In particular, the *Leadership* dimension captures the institutional structure of each project, focusing on the identity of the *Programmer* (e.g. ministry, region, province, private firm), and reflects the vertical allocation of governance responsibilities (Pentland, 1997; OECD, 2020).

The *Beneficiary* area distinguishes four categories: *Single Private*, *Single Public*, *Multiple Public*, and *Private–Public*, depending on the composition of the projects final beneficiaries (that might be multiple) (OECD, 2025).

The *Activation* dimension concerns variables accounting for the procedures used to activate projects and select beneficiaries, that can vary from competitive procedures (e.g. open calls) to more discretionary mechanisms, such as direct allocations or expressions of interest (Crescenzi et al., 2021).

The *Complexity* dimension captures the organisational and territorial structure of projects, including indicators for multiple beneficiaries, multi-territorial implementation, "unique actor" arrangements (where programmer and beneficiary coincide), and private–public co-financing, which may reflect collaborative implementation (Dąbrowski, 2014; Carley and Christie, 2017).

To construct the dataset of transition-related projects, we restrict attention to projects explicitly contributing to the twin transition (green and digital[1]). For S3, project-level information was retrieved from the official Research and Innovation Cohesion Policy database in May 2024, restricting the sample to initiatives financed through the European Regional Development Fund (ERDF), and within Thematic Objective 1 (Research and Innovation). For the NRRP, relevant projects were identified within Missions M1 (Digitalisation, Innovation, Competitiveness, Culture and Tourism), M2 (Green Transition), and M4 (Education and Research)[2].

In addition, sectoral alignment based on project-identifying codes (CUP) allowed for a coherent classification of projects irrespective of their policy origin, ensuring analytical consistency.

In particular, looking at projects in sectors related to *Plants, equipment and facilities*, *Research and innovation* and *Business support services*. This harmonization process enables direct comparison between S3 and NRRP investments at the municipal level, in sectors relevant to the twin transition priorities.

Table 1 shows a side-by-side comparison of the samples of the two policy frameworks.

Table 1: Sectoral Distribution of Projects under S3 and NRRP

	S3		**NRRP**	
Sector	**Freq.**	**%**	**Freq.**	**%**
Plants, equipment, and facilities	1,243	10.8	5,497	45.2
Research and innovation	7,283	63.2	618	5
Business support services	3,003	26	6,052	49.8
Total	**11,529**		**12,167**	

The sample for S3 projects represents around 10% of total ERDF resources, while transition-related NRRP projects account for roughly 13% of the NRRP budget.

Figure 1 illustrates the territorial distribution of project-level funding for the two policies.

Visual inspection of the maps indicates that a larger number of municipalities remain unfunded under the S3 framework relative to the NRRP, although areas of overlapping investment are also evident. In particular, the descriptive evidence suggests that, under S3, municipalities in Puglia and Tuscany feature more prominently among the recipients of twin-transition funding, whereas those in Calabria appear least likely to receive support. By contrast, the NRRP allocation displays a more capillary distribution across Italy, with notably higher participation among municipalities — especially in Emilia-Romagna, Lombardy, and Veneto — that do not appear as beneficiaries under S3.

Figure 2 shows the distribution of municipalities by funding status under the two policies. Municipalities fall into four mutually exclusive categories: funded by both policies, funded only by the NRRP, funded only by S3, or not funded. Although no strong geographic pattern emerges from the figure overall, a noticeable concentration of unfunded (red) municipalities appears along the Southern Apennines. A numerical summary of the distribution is provided in Table 2

Out of the full municipal sample, 3,971 municipalities received no funding from either policy, while 1,249 municipalities benefited from both S3 and NRRP investments. Notably, NRRP exhibits broader territorial coverage, reaching 3,062 municipalities compared to 1,792

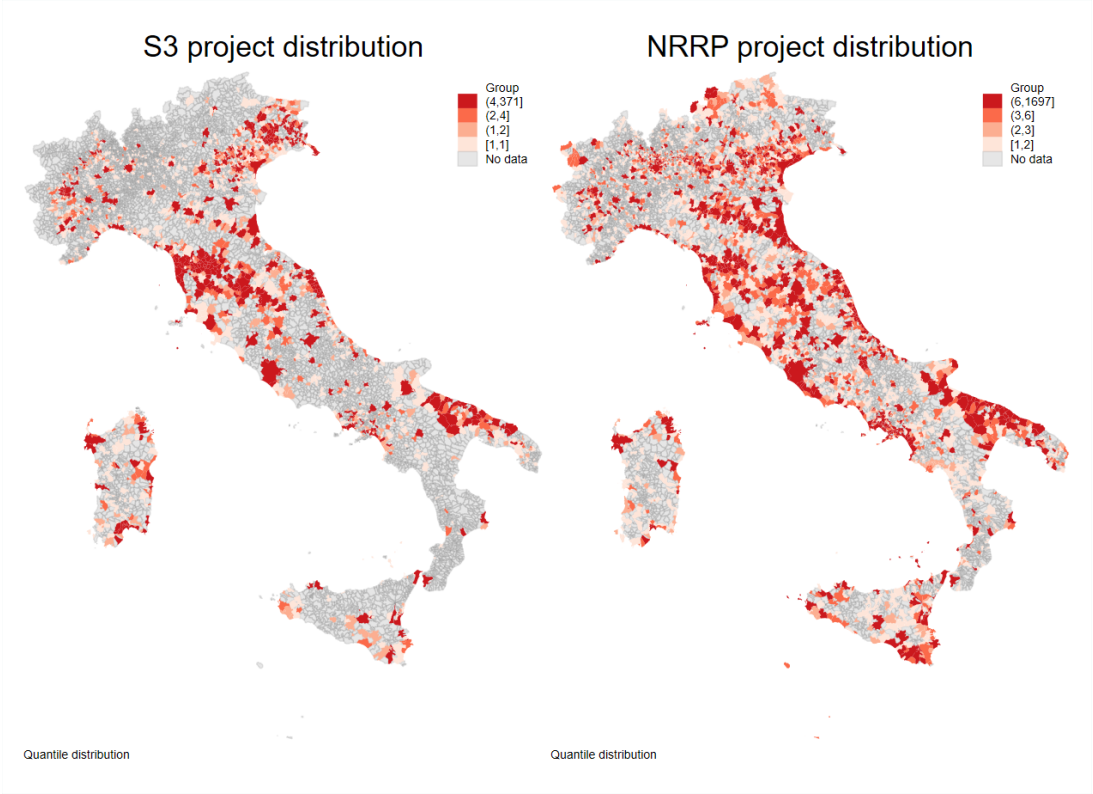


Figure 1: Territorial distribution

Note: S3 investments on the left and NRRP projects on the right. Municipalities shaded in red have received at least €1 in funding under the respective policy. The intensity of the red color corresponds to the number of funded projects: lighter shades indicate fewer projects, while darker shades represent higher project density. Municipalities shown in grey have no funded projects in the dataset.

for S3.

Table 2: Municipal participation

	S3		
NRRP	No	Yes	Total
No	3,971	542	4,513
Yes	1,813	1,249	3,062
Total	5,784	1,792	7,575

Moreover, from our sample, we find that 52.4% of municipalities do not receive any funding from either policy, 7.2% receive funding only from S3, 23.9% receive funding only from NRRP and 16.5% receive funding from both policies.

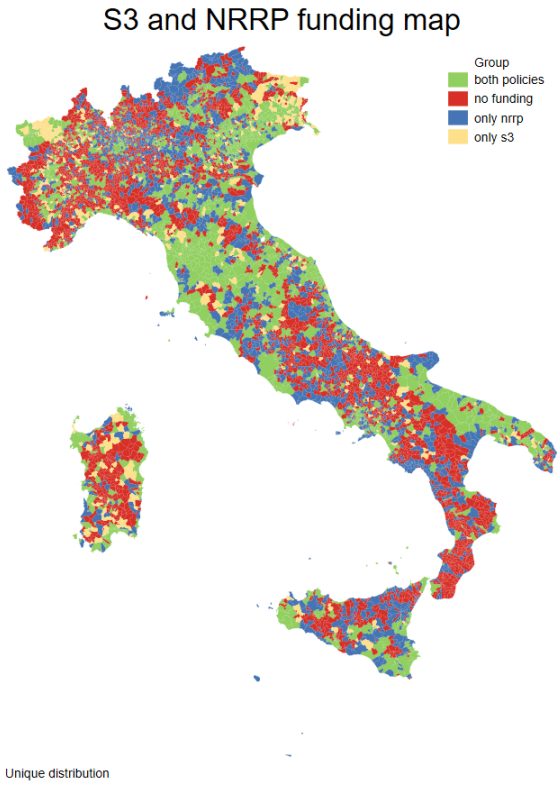


Figure 2: Territorial distribution of groups

Note: Green municipalities received funding from both policies; red received no funding; blue only from the NRRP; yellow only from S3.

3.4 Empirical Strategy

Figure 3 summarises the empirical strategy. Municipalities are first classified into four mutually exclusive groups based on funding status: funded by both policies, funded only by NRRP, funded only by S3, or not funded.

Firstly, a multinomial logit model is then used to identify the territorial, socio-economic, and administrative characteristics associated with participation in each implementation framework.

Then, municipalities are grouped into recipients and non-recipients. Propensity score matching is applied to identify recipient municipalities that are structurally similar to non-recipient ones. Based on this comparison, a binary indicator is constructed among recipients, equal to one for municipalities that resemble non-recipients and zero otherwise. This indicator is used as the outcome variable in machine learning models to identify which *modes of governance* are associated with inclusive participation. SHapley Additive exPlanations (SHAP) are employed to assess the direction and relative importance of each feature.

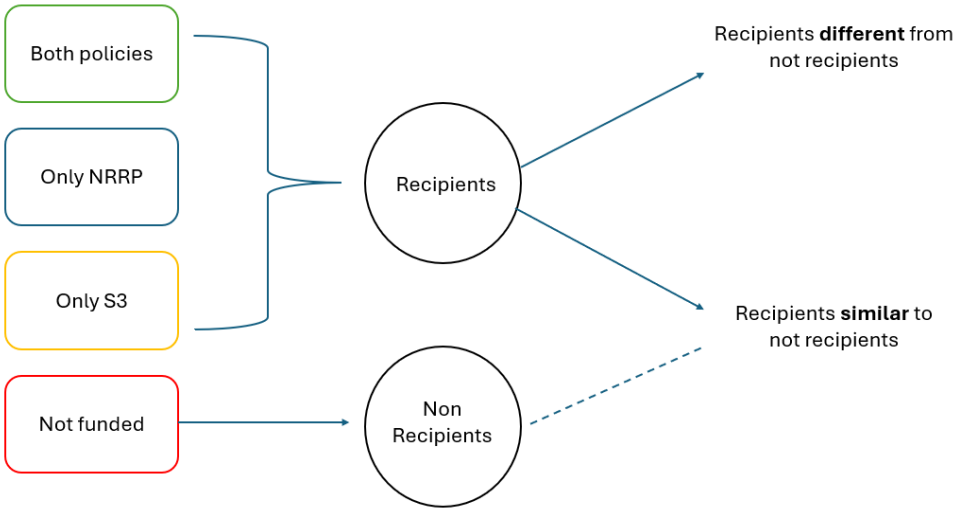


Figure 3: Dependent variable composition in different stages of the analysis

3.4.1 Multinomial logit for territorial characteristics

A multinomial logit model identifies the factors associated with municipalities' probability of belonging to different policy implementation categories, allowing us to compare the characteristics of the different subgroups

Our classification of *policy inclusiveness* differentiates municipalities by their participation in transition-oriented policies: not funded, NRRP-only, S3-only, and Dual participation (funded by both policies). Formally, let $Y_i \in \{0, 1, 2, 3\}$ denote the outcome for municipality i, with $Y_i = 0$ for non-beneficiaries, $Y_i = 1$ for NRRP-only, $Y_i = 2$ for S3-only, and $Y_i = 3$ for dual beneficiaries i.e., municipalities that have benefited from both policies.

The equation (1)

$$\mathbb{P}(Y_i = j \mid \mathbf{X}_i) = \frac{\exp\left(\mathbf{X}_i'\boldsymbol{\beta}_j\right)}{1 + \sum_{\ell=1}^{3} \exp\left(\mathbf{X}_i'\boldsymbol{\beta}_\ell\right)} \quad \text{for } j = 1, 2, 3,$$

provides the estimated probability of a municipality belonging to a certain policy participation category $\boldsymbol{\beta}_j$, compared with the base category $j = 0$ (which in our case is municipalities that have received no funding from S3 and NRRP), as a function of a series of explanatory variables $\mathbf{X}_i$. This vector includes averaged municipal-level covariates over 2014–2023 [3] to capture structural, socio-economic, and innovation-related characteristics, as well as governance and territorial factors.

In particular, the model's covariates are selected to capture the structural and institutional

features most relevant to territorial inclusion in innovation policy (e.g., Rodríguez-Pose, 2018), highlighted in section 2. Our main interest lies in a set of municipal-level variables capturing key sources of territorial heterogeneity, including population size, settlement structure, macro-regional location, and peripherality. Urbanization is included as a categorical variable, while population is included as a continuous municipal-level variable, capturing differences in spatial agglomeration. While macro-regional location is captured through a binary indicator equal to one for municipalities located in Southern Italy and the Islands, and zero otherwise, reflecting the persistent Italian North–South divide and the concentration of Less Developed Regions. "Peripheral status" refers to a municipality's structural disadvantage in terms of accessibility, service provision, and socio-economic opportunities compared to central or urban areas. To operationalize this concept, we rely on the SNAI (National Strategy for Inner Areas) classification, which provides an officially recognized and widely accepted definition of peripheral municipalities [4]. Specifically, we construct a binary indicator equal to one if a municipality is classified as intermediate, peripheral, or ultra-peripheral (i.e. classificed as an *inner area* according to the SNAI classification), and zero otherwise.

We control for economic capacity using two continuous municipal-level variables: average income per capita, drawn from administrative tax records provided by the Italian Ministry of Economy and Finance (MEF), and the entrepreneurship rate, measured as the number of active local business units per 1,000 inhabitants using ISTAT data.

Innovation potential is captured through continuous municipal-level indicators of patent activity and intangible assets. Patent activity is measured using patent counts from ORBIS, while information on intangible assets, which correspond to firms' intangible fixed assets, is drawn from firm-level balance sheet data provided by AIDA and aggregated at the municipal level and expressed as the percentage ratio between firms' intangible fixed assets and their total net assets.

Finally, mayoral characteristics are included to account for observable differences in local political capacity and leadership profiles that may be relevant for engaging with complex policy instruments. Specifically, we consider the mayor's age (continuous variable) and a binary indicator equal to one if the mayor holds a tertiary education degree, and zero otherwise. These variables capture heterogeneity in leadership profiles and administrative capacity, as existing evidence suggests that younger and more educated political leaders tend to be associated with greater openness to policy innovation and better administrative performance (Besley et al., 2011;

Ferraz and Finan, 2011; Brezzi et al., 2014).

Data on mayoral characteristics are sourced from the Italian Ministry of the Interior. All variables are measured at the municipal level and averaged over the period 2014–2023 to capture structural characteristics and reduce the influence of short-term fluctuations. A detailed description of variable definitions and data sources is provided in Table B2 in Appendix B.

This approach enables a comparative assessment of how municipal structural characteristics are associated with municipalities' probability of participating in the bottom-up S3, the top-down NRRP, or both governance frameworks.

This approach while providing a nuanced view of how different implementation frameworks may interact with municipal characteristics, shedding light on the structural conditions that facilitate or hinder participation in transition policies.

3.4.2 Machine learning for inclusive territorial participation

This section shifts the focus from implementation frameworks to modes of governance, which we define as the ability of transition policies to involve local actors that were ex ante unlikely to receive funding. The objective is to identify whether specific *modes of governance* are associated with more inclusive outcomes of territorial participation.

To do so, a propensity score matching approach pairs funded municipalities ("recipients") with similar non-funded ones ("non-recipients") to isolate structurally comparable territories. Using covariates already introduced in the multinomial logit (e.g., income, urbanity, peripherality), PSM identifies for each municipality 3 similar ones.

Municipalities in which local actors that receive funding are located are reclassified by their similarity to those with no-recipients:

$$e(X_i) = P(T_i = 1 \mid X_i) = \Lambda(X_i'\beta) = \frac{\exp(X_i'\beta)}{1 + \exp(X_i'\beta)},$$

where $T_i = 1$ if municipality i did not receive funding and $T_i = 0$ otherwise, and X_i is a vector of observed characteristics.

Each recipient is then flagged with an inclusiveness indicator:

$$D_i = \begin{cases} 1 & \text{if municipality } i \text{ has a propensity score similar to non-recipient municipalities,} \\ 0 & \text{otherwise.} \end{cases}$$

This D_i indicator will serve as the dependent variable in machine learning models that pinpoint project-level *modes of governance* driving inclusive participation. With over 30 project-level variables, ML excels at detecting complex nonlinear relationships and interactions beyond traditional regressions. First, we compare model performance to identify the best-performing predictive algorithm. Then SHapley Additive exPlanations (SHAP) analysis reveals key drivers like centralized leadership or public-private partnerships. This approach reveals which *modes of governance* — e.g., centralized leadership or public-private partnerships — boost local participation in municipalities that ex ante would have not been included.

In particular, we train several classifiers — Elastic Net, Support Vector Machine, Random Forest, and Gradient Boosting — using project-level features. These models capture potentially non-linear relationships between governance characteristics and inclusiveness.

Following standard practice in machine-learning-based policy evaluation, the dataset is randomly split into 70% training and 30% testing samples, stratified by policy (NRRP vs. S3) and by less developed regions. This procedure ensures comparable distributions across subsamples and allows for an unbiased evaluation of predictive performance.

This approach makes it possible to identify the governance configurations under which innovation policies are more likely to reach structurally disadvantaged municipalities.

Machine learning methods are increasingly used in informative policy analysis, including studies on access to the European Agricultural Fund for Rural Development (Caravaggio et al., 2025b), tax auditing (Battaglini et al., 2025), and social welfare provision (Battiston et al., 2024).

3.5 Results

3.5.1 Contextual factors affecting municipal participation in transition policy governance frameworks: multinomial logit specification

The multinomial logit model examines how the likelihood of belonging to different categories of policy participation—namely non-beneficiaries, NRRP-only, S3-only, and dual beneficiaries—relates to key structural, socio-economic, and institutional characteristics at the municipal level.

Results are presented as Relative Risk Ratios (RRRs). In the multinomial logit framework, RRRs express how differences in municipal characteristics are associated with the relative

likelihood of belonging to each policy participation category (NRRP-only, S3-only, or both), compared to the reference category of non-funded. Values above one indicate a higher relative likelihood of participation in a given category, while values below one indicate a lower relative likelihood, conditional on all other covariates[5].

Multinomial logit estimates (Table 3) reveal strong and significant territorial and structural patterns in municipal participation across the two policy approaches — the bottom-up S3 and the top-down NRRP.

Table 3: Multinomial logit results

	Funding Participation		
Variable	**Both Policies**	**Only NRRP**	**Only S3**
Income	4.785***	2.216***	2.732***
Entrep. rate	1.043***	1.034***	1.014***
Population	1.000***	1.000**	0.999*
Urbanization	1.675***	1.180**	1.387***
South/Islands	1.432***	1.372***	0.832
Peripheral	0.529***	0.958	0.490***
Intangible assets	1.000	1.001**	1.000
n. patents	1.001***	1.000	1.000**
Mayor age	0.991	0.992**	0.999
Mayor tertiary education	0.926	1.125**	1.031
Constant	3.35e-14***	5.71e-08***	7.94e-09***
Obs.		7,296	
R^2		0.2372	

The estimates reveal a strong and statistically significant association between indicators of *economic dynamis*—income levels and entrepreneurship rates—and the relative likelihood of receiving funding from both policies, with economically stronger municipalities consistently exhibiting higher participation across the two frameworks. In particular, income displays a large and statistically significant association with dual participation: the estimated RRR of approximately four indicates that municipalities with higher income levels have a substantially higher relative likelihood of receiving funding from both S3 and NRRP, compared to non-beneficiaries, holding other characteristics constant.

Demographic and *spatial characteristics* display heterogeneous associations with policy

participation. Population size is statistically significant but associated with RRRS very close to one, indicating no substantively meaningful relationship with participation across categories. In contrast, *urbanization* exerts a strong and positive influence across all categories. This supports the idea that agglomerated contexts possess stronger administrative and absorptive capacities, making them better positioned to mobilize resources under both implementation frameworks. This finding aligns with the extensive literature on spatial agglomeration and innovation dynamics (e.g., Crescenzi and Rodríguez-Pose, 2011), which highlights how higher density and functional centrality foster knowledge diffusion, administrative capacity, and policy absorption.

A clear *territorial divide* also emerges. Municipalities in the South and Islands are significantly more likely to participate in the NRRP and to combine both policy frameworks, reflecting the explicit territorial targeting of less developed regions through Recovery measures (i.e., at least 40% of territorially targeted investments are mandated to take place in the Southern and Islands regions). In contrast, the coefficient for S3-only participation is not statistically significant for municipalities located in the South and Islands, indicating no systematic association with participation in S3.

Peripheral municipalities exhibit significantly lower relative likelihoods of participation in both S3-only and dual policy categories compared to non-peripheral municipalities. The estimated RRRs are well below one for both S3-only participation (RRR = 0.49) and dual participation (RRR = 0.52), indicating a substantially lower likelihood of accessing innovation-related funding. This pattern is consistent with the presence of persistent structural constraints—such as limited administrative capacity, weaker institutional networks, and lower accessibility—that may hinder local engagement with innovation policies. In line with the literature on territorial fragility and uneven development (Barca, 2009; Rodríguez-Pose, 2018); Dijkstra et al., 2021), these results highlight how bottom-up policy frameworks, such as S3, tend to privilege already capable territories. Rather than compensating for structural disadvantages, they risk reinforcing existing spatial divides, questioning the capacity of place-based approaches per se to deliver territorial cohesion, especially when those tools require strategic planning and stakeholder engagement (as in S3).

Turning to *innovation capacity* and *local leadership*, the estimated associations are comparatively modest. Patent activity shows a small but statistically significant association with both S3-only and dual participation, while intangible assets matter slightly for NRRP-only munici-

palities. Although these effects are numerically negligible, their consistent direction suggests that pre-existing innovation infrastructures may facilitate access to policy opportunities.

Similarly, *mayoral characteristics* display only limited associations with participation outcomes. Younger mayors and those holding a tertiary education degree exhibit a slightly higher relative likelihood of leading municipalities participating in NRRP-only projects. Importantly, this association does not extend to S3 participation, suggesting that individual leadership attributes are primarily relevant within the more centralized and procedurally driven NRRP. Nonetheless, the magnitude of these associations remains small, indicating that economic and territorial fundamentals play a more prominent role than innovation and leadership factors in shaping policy participation.

Our results challenge simplistic assumptions about implementation frameworks. Despite their contrasting logics, neither the top-down NRRP nor the place-based S3 succeeds in reaching weaker territories. In contrast to policy objectives, peripheral municipalities remain systematically excluded and do not succeed in accessing both funding streams. This outcome raises major concerns for the cohesion objective and exposes the limits of both implementation frameworks in engaging structurally disadvantaged areas in strategic transition policies planning.

This confirms the limits of explanations based solely on policy frameworks and points to the relevance of examining participation at a more granular level of analysis. In particular, it directs attention to how policies are implemented in practice, through project-level *modes of governance*.

The following section therefore, focuses on these *modes of governance*, analysing how project-level implementation arrangements condition participation patterns and the inclusiveness of transition-oriented policy implementation.

3.5.2 Which *modes of governance* foster inclusiveness?

To further investigate the relationship between municipal characteristics and participation in implementation frameworks we match municipalities that did not receive any funding (non-recipients) to those that did (recipients), using a nearest-neighbor algorithm (with three neighbors and a caliper of 0.15) based on covariates drawn from the multinomial logistic regression model. This allows to identify municipalities that are structurally comparable in terms of observable characteristics, in order to understand how different modes of governance affect inclusiveness.

Propensity score model is presented in Appendix in Table B3, is shows that observable characteristics strongly predict the likelihood of not receiving funding. Municipalities with higher average taxable income and larger resident populations are significantly less likely to be receivers, suggesting that wealthier and more urban areas were more likely to access funding. Conversely, being located in a "less developed area" or being a peripheral municipality significantly increases the probability of not receiving funding. The model displays good predictive power (Pseudo-R^2 = 0.264).

Post-matching balance is presented in Table 4. The balance statistics show that propensity score matching is highly effective in identifying municipalities that received funding but are structurally similar to those that did not.

Before matching, the two groups were clearly different across key socio-economic and territorial characteristics. Income and population exhibit very large standardized biases, indicating that recipients were, on average, wealthier and more populated than non-recipients. Urbanisation also differs substantially, and even territorial classifications display statistically significant imbalance. These results highlight that, prior to matching, recipients and non-recipients do not provide a suitable basis for direct comparison.

After matching, covariate balance improves significantly. For income, population, and urbanisation, standardized bias drops close to zero and post-matching mean differences become statistically insignificant. This implies that the matching procedure successfully isolates a subset of recipients whose structural characteristics closely resemble those of non-recipients.

Overall, the results confirm that the matching exercise achieves its core objective: it identifies recipient municipalities that are comparable to non-recipient ones in terms of socio-economic and demographic fundamentals. This reinforces the need of further analysis on project-level *modes of governance*.

Table 4: Covariate Balance Before and After Matching

Variable	Mean Recipients	Mean Non-Recipients	Std. Bias	Bias Reduct. (%)	p-value
Panel A: Before Matching					
Log Income	16.543	18.082	-130.3	–	0.000
Population	2,192.2	13,480	-25.8	–	0.000
Urbanization	2.796	2.389	78.5	–	0.000
Less developed area	0.317	0.266	11.3	–	0.000
Peripheral	2.961	2.958	1.1	–	0.625
Panel B: After Matching					
Log Income	16.548	16.549	-0.0	100.0	0.985
Population	2,195.5	2,181.8	0.0	99.9	0.838
Urbanization	2.796	2.793	0.6	99.3	0.749
Less developed area	0.318	0.297	4.5	60.3	0.049
Peripheral	2.961	2.970	-3.0	-164.7	0.151

Notes: Table reports pre- and post-matching covariate means for recipient and non-recipient municipalities, standardized percent bias, bias reduction, and t-test statistics from `pstest`. Matching was performed using nearest-neighbor propensity score matching with a caliper of 0.15 and 3 neighbors. Std. Bias is the standardized difference in means. A reduction in standardized bias below 5% and statistically insignificant post-matching mean differences indicate successful balance.

The matching diagnostics indicate that the matching procedure achieved excellent covariate balance. Before matching, all covariates were significantly imbalanced, with mean standardized bias at 49.4%. After matching, standardized bias fell to 1.6%, LR tests become insignificant, and both B and R statistics fall within acceptable ranges. Variance ratios for matched covariates lie close to 1, indicating balanced dispersion. Overall, the matching procedure successfully eliminated selection on observables and supports the validity of the conditional independence assumption.

Building on the matching results, a Machine Learning approach is undertaken, were we train several classifiers — Elastic Net, Support Vector Machine, Random Forest, and Gradient Boosting — using project-level modes of governance as our predictors. These models capture potentially non-linear relationships between governance characteristics and inclusiveness. Therefore, at first prediction quality has to be assessed, by comparing prediction quality of the different algorithms. Then, to interpret these results, we employ SHAP values, which quantify the marginal contribution of each predictor to inclusiveness.

Our dependent variables takes value 1 if the project is localised in a municipality that shares characeristics with those that ex ante were not likely to participate, while it takes value 0 if it is different. The two groups are statistically different, as shown in Table B4 in Appendix B.

Table 5 reports the comparative predictive performance of the four candidate models —Random Forest, Gradient Boosting Machine (GBM), Elastic Net, and Support Vector Machine with radial kernel (SVM-radial) — using two complementary metrics: the Area Under the Receiver Operating Characteristic Curve (ROC AUC) and the Area Under the Precision–Recall Curve (PR AUC). While ROC AUC provides a measure of a model's ability to discriminate between the positive and negative classes across all classification thresholds, PR AUC is particularly informative in settings with class imbalance, as it focuses on the trade-off between precision and recall for the minority (positive) class.

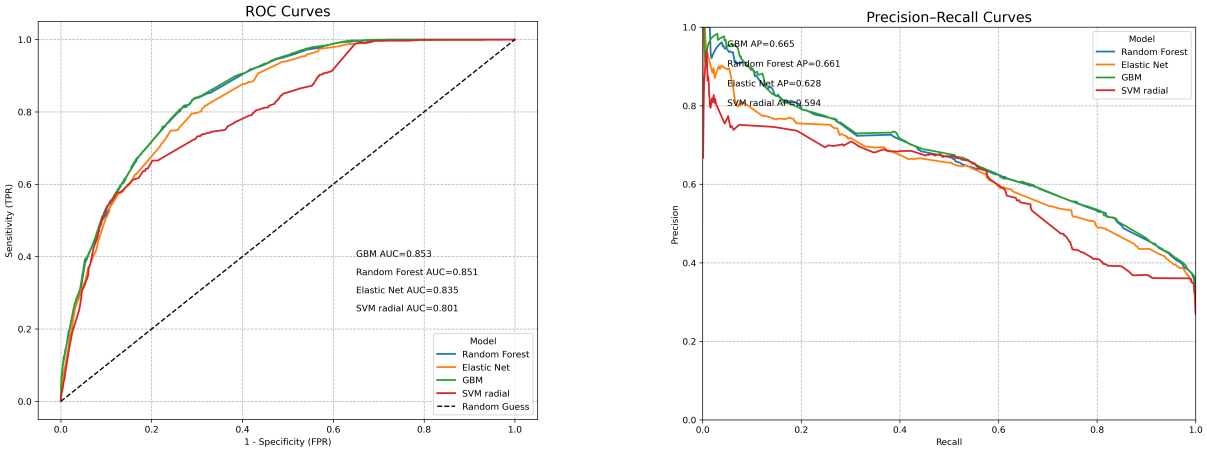
Across both evaluation metrics, the Gradient Boosting Machine exhibits the strongest performance, achieving the highest ROC AUC (0.853) and PR AUC (0.665). This indicates that GBM not only distinguishes well between classes overall but also maintains a favourable balance between correctly identifying positive cases (recall) and limiting false positives (precision). Random Forest ranks second, with performance only marginally below that of GBM (ROC AUC = 0.851; PR AUC = 0.661), suggesting that it is a competitive alternative, particularly if model interpretability or computational cost were to be considered.

Elastic Net achieves moderate predictive performance, outperforming SVM-radial on both metrics, which reflects its effectiveness as a regularized linear model when capturing linear relationships with some complexity. In contrast, the SVM-radial model consistently yields the lowest values for both ROC AUC (0.800) and PR AUC (0.593), indicating weaker discrimination capability and inferior performance in identifying positive instances with acceptable precision.

Figure 4a and Figure 4b (ROC and PR curves) further illustrate these results by showing the relative separation of the curves across thresholds, with GBM dominating the other models

Table 5: Model comparison

Model	ROC AUC	PR AUC
Random forest	0.851200	0.661355
GBM	0.853479	0.665196
Elastic Net	0.835232	0.627606
SVM radial	0.800966	0.593719



(a) ROC results

(b) PCR results

Figure 4: ROC curve (left) and Precision–Recall curve (right) for the four models.

throughout most of the threshold range. Taken together, the evidence strongly suggests that GBM provides the most reliable predictive performance for this problem setting, particularly in relation to identifying minority-class cases with acceptable precision.

Pairwise comparison of ROC curves using DeLong's test was performed between the two top-performing models: Gradient Boosting Machine (GBM) and Random Forest (RF). The null hypothesis states that the two AUCs are equal; a significant p-value indicates that the performance difference is statistically meaningful.

The GBM significantly outperformed RF (ΔAUC = +0.0023, Z = 227.88, $p < 0.001$). Although the absolute difference is small, the statistical significance confirms that GBM's advantage is not due to random chance.

The GBM achieved the highest predictive performance (AUC = 0.8535), with the Random Forest close behind (AUC = 0.8512). Given its statistically superior performance, we select GBM as the final model for subsequent feature importance and policy impact analyses.

The GBM model was optimized with the following hyperparameters: learning rate = 0.1, maximum tree depth = 6, and number of estimators = 100. These parameters balance model

Table 6: Statistical Comparison of Top Models

	GBM	RF	Difference	p-value
ROC AUC	0.8535	0.8512	+0.0023	< 0.001

complexity with generalization ability, as determined through 5-fold cross-validation.

How *modes of governance* influence inclusiveness To assess how the modes of governance shape inclusiveness, having established that the GBM is the best-performing model for this task, we turn to its variable importance measures to understand which features drive policy outcomes in terms of inclusiveness. We calculated SHAP (SHapley Additive exPlanations) values for each binary feature when its value equals 1. The resulting impact spectrum (Figure 5) orders features by their mean absolute SHAP value, revealing which characteristics most strongly influence the predicted probability of the outcome. In particular, because the dependent variable equals one when a project is inclusive (i.e. is located in a municipality that is similar to non recipient municipalities), positive SHAP values signal *modes of governance* that promote inclusiveness, while negative values indicate the contrary.

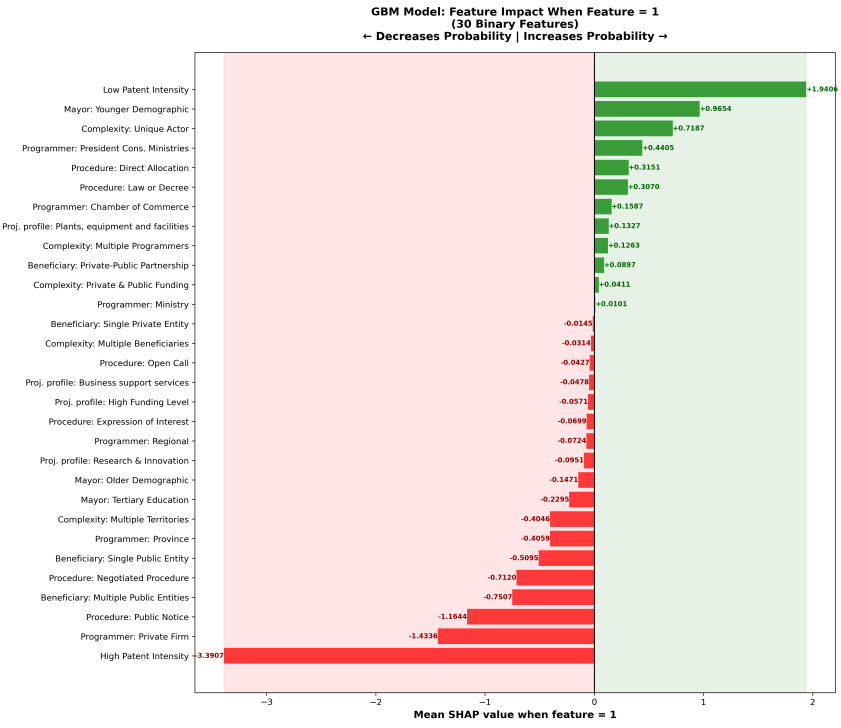


Figure 5: Shapley additive explanations

Note: Green bars show positive infleunce on inclusiveness; red bars display negative influence on inclusiveness.

Grouping these features within the established taxonomy of modes of governance (cfr. Table B1) yields a clear structure in the determinants of inclusiveness.

Firstly, *project profiles* do not play a significant role while following consistent patterns. Equipment-oriented projects are more prevalent in disadvantaged municipalities, while projects with above-average funding or service-oriented and R&I interventions slightly reduce the likelihood of inclusiveness.

In terms of *Leadership*, projects programmed by the Presidency of the Council of Ministers exhibit positive contributions to inclusiveness, implying that central strategic leadership favors disadvantaged territories. Conversely, projects programmed by private firms or provinces tend to include predominantly advantaged municipalities, therefore it is better not to program them by private firms or provinces. The regional and ministerial programming exert a smaller role following similar patterns. This cluster of findings points to centralized public leadership as a facilitator of inclusive territorial programming, while when a private or subnational bureaucratic leadership is designated, projects are more likely to concentrate in more advantaged municipalities.

The *beneficiary* structure also significantly shape the territorial distribution of projects. Public–private beneficiary coalitions increase the probability that a project can be located in a disadvantaged area, suggesting that hybrid governance arrangements are particularly conducive to inclusive allocation. In contrast, purely public configurations can be problematic — especially those involving a single public beneficiary — display strong negative contributions, indicating that these arrangements tend to arise in more advantaged municipalities. Multiple public beneficiaries also reduce the likelihood of inclusiveness, although to a lesser extent. These results suggest that hybrid beneficiary structures foster territorial inclusion, whereas more traditional public-only constellations are associated with a concentration of projects in more advantaged areas.

Activation procedures constitute the second most influential governance dimension shaping inclusiveness. Projects activated via financing laws or decrees display substantial positive contributions, suggesting that centralized, legally grounded instruments are more frequently associated with projects extended toward disadvantaged territories. In contrast, public notices and negotiated procedures exert large negative effects, indicating that more formalistic or bilateral activation channels are disproportionately linked to projects implemented in more advantaged areas. Open calls and expressions of interest provide small negative effects. Taken together,

the results reveal that activation mechanisms with strong central steering and less procedural fragmentation are more likely to channel projects toward disadvantaged municipalities, whereas decentralized or competitive approaches, that require more bottom-up capacities, hinder inclusiveness.

If the objective is to foster inclusiveness towards less advantaged areas, projects with a unique actor as programmer and beneficiary or with multiple programmers should be chosen, as they both show a strong positive effect, indicating that unified governance structures are more likely to channel projects to disadvantaged areas and that multi-agency leadership can reinforce inclusiveness. In contrast, projects spanning multiple territories yield a notable negative effect — implying that multi-territorial coordination tends to favor more advantaged municipalities, possibly due to administrative barriers or capacity asymmetries. Co-financing arrangements exhibit a mild positive effect. Collectively, these patterns indicate that governance configurations that have the same programmer and beneficiary or that promote coordination across programmers tend to enhance inclusiveness, whereas complex territorial coordination may undermine it.

Contextual conditions obviously play a predominant role in explaining the possibility of local actors, in disadvantaged municipalities, of participating. Among them, the patent-based indicators — high-patenting vs. low-patenting municipalities — produce the largest SHAP values. In part, it is important to be innovative, as the patent feature shows, but results point to the fact that political demography also matters, as shown by the influence of mayoral characteristics.

Taken together, these findings indicate that specific *modes of governance* meaningfully shape the prospects for an inclusive territorial transition. Governance arrangements that centralize authority and streamline decision-making — such as a centralized leadership, direct activation procedures, having multiple programmers and public–private beneficiary structures — systematically increase the likelihood of participation of disadvantaged municipalities. In contrast, governance modes marked by competitive procedures, public-only beneficiary arrangements, or multi-territorial coordination are associated with allocations skewed toward more advantaged areas, thereby limiting the reach of the transition. While contextual features remain strong predictors of structural disadvantage, the results collectively show that *modes of governance* themselves contribute to widening or narrowing spatial inequalities. In this sense, procedural, organisational, and relational configurations structuring project design, coordination, and delivery (i.e. *modes of governance*) do not merely accompany the territorial allocation process — they actively condition whether public investment becomes a vehicle for an inclusive transition.

3.6 Robustness checks: CUP–Based Sample Splits

To assess the stability of our main findings, we split the sample based on the CUP sector, to identify is there are specific sectoral patterns across different local productive specializations that may drive our results. The multinomial logit model was re-estimated on three subsamples determined by CUP sector: (i) Plants, equipment and facilities, (ii) Research and innovation, and (iii) Business support services. Results are presented as Relative Risk Ratios (RRRs). In the multinomial logit framework, RRRs express how differences in municipal characteristics are associated with the relative likelihood of belonging to each policy participation category (NRRP-only, S3-only, or both), compared to the reference category of non-funded.

Overall, the sample splits confirm the robustness of the core results obtained in the full specification, although some differences emerge in territorial sensitivity and specialization.

3.6.1 Plants, equipment and facilities subsample

Table 7: Multinomial Logit — Equipment CUP municipalities

	Both Policies	**Only NRRP**	**Only S3**
log media IRPEF	6.14***	2.02***	2.68***
Entrepreneurial rate	1.04***	1.04***	1.00
Innovation score	1.00	1.00**	1.00
Publications	1.00**	1.00	1.00
Age (mayor)	1.00	0.99*	0.98
Mayor tertiary educ.	0.95	1.18**	0.82
Population	1.00***	1.00***	1.00
Urbanisation S3	2.36***	1.56***	1.55**
Less developed region	1.84***	1.54***	0.23***
Peripheral	0.46***	0.89	431.19***
Pseudo–R2		0.293	
N		5,910	

The results from the multinomial logit model for CUP sector relative to Plants, equipment and facilities investments displays very strong income effects: a 1% increase in mean income increases the likelihood of combined funding by more than six times relative to no funding, and doubles the probability of NRRP-only participation. Urban municipalities and those in less developed regions are also significantly more likely to receive funding, whereas Peripheral areas are strongly disadvantaged under the combined scheme.

Notably, the S3–only category shows a dramatic positive association with internal areas

(RRR > 430), revealing a spatial specialization: CUP–S3 equipment funding is almost entirely rural/inner-area driven and not explained by socio-economic variables.

3.6.2 Research and Innovation subsample

Table 8: Multinomial Logit — Research and Innovation CUP municipalities

	Both Policies	**Only NRRP**	**Only S3**
log media IRPEF	5.28***	2.50***	3.45***
Entrepreneurial rate	1.04***	1.02	1.02***
Innovation score	1.00	1.00	1.00
Publications	1.00***	1.00**	1.00**
Age (mayor)	0.98**	0.97*	1.00
Mayor tertiary educ.	0.96	1.68*	1.25*
Population	1.00**	1.00*	1.00**
Urbanisation S3	1.59***	0.93	1.36**
Less developed region	1.90***	0.55	1.36*
Peripheral	0.91	0.52	0.66*
Pseudo–R2		0.406	
N		5,144	

The Research and innovation subsample shows the strongest predictive performance of all three models (Pseudo–R2 = 0.406). IRPEF levels again significantly influence combined and S3 funding choices, signalling that wealthier research municipalities are more capable of accessing diversified funding streams.

Scientific productivity (publications) becomes statistically significant across all outcomes, confirming that S3 and research funding are awarded where measurable knowledge production exists.

In contrast to the equipment model, internal areas are not systematically penalised. The magnitude of coefficients suggests a more balanced territorial distribution of R&I funds across urban and rural zones.

3.6.3 Business support services subsample

Table 9: Multinomial Logit — Services CUP municipalities

	Both Policies	**Only NRRP**	**Only S3**
log media IRPEF	5.16***	3.02***	2.88***
Entrepreneurial rate	1.05***	1.03***	1.02***
Innovation score	1.00	1.00	1.00
Publications	1.00***	1.00**	1.00
Age (mayor)	0.99	0.99	1.00
Mayor tertiary educ.	0.90	0.99	0.72*
Population	1.00**	1.00	1.00
Urbanisation S3	1.51***	0.91	1.58**
Less developed region	1.46***	1.49***	0.42***
Peripheral	0.46***	1.36	0.24***
Pseudo–R2		0.322	
N		5,957	

In the Business support services subsample, income effects remain very strong for all funding types, confirming that fiscal capacity and average tax base shape project readiness and public administration capabilities. The only–S3 category again appears territorially specialised: internal areas are three to four times less likely to access this stream, while urban municipalities show increased likelihood. Service projects therefore tend towards concentration in urban centres, reflecting economies of scale and labour market dynamics.

3.6.4 Overall robustness cheks results

Across all subsamples, three key results emerge. Log income is the strongest and most consistent predictor in all models, showing that fiscal capacity significantly increases the probability of obtaining any form of funding, but especially joint NRRP–S3 financing. Entrepreneurial environment matters as it is repeatedly significant and positive, suggesting local production structure capacity drives successful access to funds. Spatial divergence across policy domains is present, where Peripheral areas behave differently across CUP categories. Overall, the estimation confirms our main findings, a persistent geography of exclusion, municipalities with higher income levels, stronger entrepreneurial activity, and urban characteristics are significantly more likely to participate in both policies.

3.7 Conclusions

This paper set out to examine how different implementation frameworks — i.e. centralised, mission-oriented, top-down frameworks, in which the central state retains primary authority and implementation is not shaped by regional discretion such as the NRRP, and decentralised, place-based, bottom-up frameworks, where subnational bodies and territorial actors design and implement development strategies autonomously, without direct central government intervention (Fratesi, 2023) — shape territorial inclusion in innovation and transition policies. In addition, it offers a more nuanced perspective by examining project-level *modes of governance* - i.e. the procedural, organisational and relational configurations that structure project design, coordination and delivery - assessing whether specific design choices foster inclusiveness. By focusing on Italy, a country marked by stark economic and administrative territorial disparities (Viesti, 2021; De Philippis et al., 2022; Cerqua et al., 2025), and employing a comparative analysis of funding participation under both policy regimes, the study offers new empirical evidence on the relationship between implementation frameworks and inclusiveness, understood as the capacity of policy frameworks and governance arrangements to enable the participation of municipalities that would otherwise be unlikely to engage, given their structural territorial, socio-economic, and administrative conditions.

Our results reveal a persistent geography of exclusion driven by policy-choices in terms of general approach and implementation configurations. Municipalities with higher income levels, stronger entrepreneurial activity, and urban characteristics are significantly more likely to participate in both policies. Peripheral and Southern municipalities — long-standing targets of EU cohesion efforts — remain unable to participate under the bottom-up governance of S3. On the contrary, from our results, top-down settings help participation of those regions that are labled as *Less Developed* and are distant from basic infrastructure (Peripheral). These patterns are robust across both regression and matching approaches and point to deep-rooted structural constraints that implementation frameworks alone may not fully overcome, challenging the prevailing paradigm advocated by proponents of bottom-up frameworks.

Crucially, the findings highlight the redistributive effects of governance choices. Nonetheless, this paper argues the necessity to give specific guidelines of the *modes of governance* that can help inclusion and can be pursued both within top-down and bottom-up frameworks. The Machine Learning approach enables to detect non linear patterns that may shape such dynamics.

The SHAP analysis of project-level modes of governance shows that institutional design significantly influence inclusion. Centralized leadership, direct activation procedures, and hybrid public–private beneficiary structures consistently enhance inclusiveness, while more competitive procedures, public-only beneficiary arrangements, or complex multi-territorial coordination are associated with allocations skewed toward advantaged areas. These results collectively indicate that *modes of governance* that streamline decision-making, centralise leadership or foster private-public collaboration enhance inclusiveness, while others — even if normatively aligned with participatory or place-based frameworks — may inadvertently reproduce spatial inequality.

Bottom-up, place-based frameworks like S3 are often promoted for their contextual sensitivity and participatory ethos (Barca, 2009; Barca et al., 2012; Rodríguez-Pose, 2018). Yet, without adequate support for administrative capacity (Bachtrögler et al., 2020) and strategic planning in weaker territories, they may reinforce existing inequalities by favoring areas already equipped to participate. Conversely, the NRRP's top-down structure appears to lower some barriers to entry for disadvantaged areas — possibly through greater standardization and national coordination — though at the risk of overlooking local needs and capabilities.

This suggests that the debate between top-down and bottom-up governance should go *beyond* reasoning in binary terms and instead examine the specific *modes of governance* embedded within the policy architecture. In particular, hybrid or adaptive governance models — combining the strategic coherence of centralised direction with the responsiveness of local engagement — may offer a more effective path forward. Importantly, any framework must explicitly incorporate mechanisms for territorial inclusion if the EU's green and digital transitions are to avoid reinforcing the spatial divides they aim to overcome.

Furthermore, this research highlights that implementation outcomes are not strictly predetermined by implementation frameworks; rather, they can be shaped by *modes of governance* that prioritize and facilitate participatory processes.

The forthcoming programming period is expected to consolidate a mission-oriented approach inspired by the logic of NGEU (Coletti and Filippetti, 2025). According to these findings, such an approach could indeed favour inclusiveness, if accompanied by specific choices in terms of projects' delivery. In the context of the post-2027 Cohesion Policy reform, and with the consolidation of mission-oriented approaches, careful attention to both overarching governance frameworks and project-level arrangements becomes essential for policy's inclusiveness. Governance is not merely an administrative dimension of transition policy; it is a key determinant

of who is able to participate to the policy and, ultimately, who benefits from structural transformation.

Finally, the paper opens several avenues for future research. While focused on Italy, the issues raised are relevant across the EU, particularly in contexts where structural disparities intersect with innovation policy. Comparative studies across member states could help clarify how institutional settings mediate the governance-inclusion relationship. Moreover, a qualitative analysis of the implementation dynamics at the local level would shed light on the mechanisms through which governance structures enable or constrain territorial participation.

In the context of the twin transition, innovation policy is no longer simply about technological advancement or economic growth — it is about managing profound structural change. Governance, therefore, is not just an administrative matter; it is a political choice with territorial consequences. The findings of this paper call for a more nuanced, inclusion-oriented approach to policy design — one that sees governance not merely as a vehicle for delivering change, but as a key determinant of who benefits from that change.

Notes

[1]The relevance of these objectives has increased over time. As documented in the Ninth Report on Economic, Social and Territorial Cohesion, Cohesion Policy has long supported environmental objectives while promoting innovation through smart specialisation platforms and partnerships aimed at strengthening regional ecosystems in line with EU priorities, particularly the green and digital transitions (EU Commission, 2024, p. 118, 176). These priorities were formalised under NGEU, where green transition and digital transformation constitute two of the six policy pillars (EU Regulation 241/2021).

[2]The NRRP data were taken as of May 2024. The Missions considered represent more than 60% of the total amount of the NRRP. Mission 2 (Green Transition) receives the largest share of resources after the 2024 revision (28.56%), followed by Mission 1 (Digitalisation) with 21.26% and Mission 4 (Education and Research) with 15.45%. The remaining missions each account for less than 13% of total funding, with Missions 5–7 together representing around 20% of the overall €194.4 billion allocation.

[3]From a methodological perspective, the cross-sectional nature of the dataset does not allow for the analysis of time-varying characteristics in the manner typical of panel data. To address this limitation, the paper uses the mean value of each variable over the period 2014 – 2023. By averaging across years, this approach captures the general trend (or central tendency) of the variable over time, thereby reducing the influence of short-term fluctuations and providing a more stable representation of its behaviour in the period (the descriptive statistics of this variation are provided in the Appendix B.

[4]In line with the ESPON (2017) classification, SNAI (i.e. National Strategy for Inner Areas) has developed an innovative framework to classify Italian municipalities according to their degree of peripherality, measured as travel-time distance from essential service provision centres (healthcare, education, and mobility).

[5]Relative Risk Ratios (RRRs) are obtained by exponentiating the estimated coefficients of the multinomial logit model. For each explanatory variable x_{ik} and outcome category j, an $RRR_{jk} > 1$ indicates that higher values of x_{ik} are associated with a higher relative likelihood of municipality i belonging to category j rather than to the base outcome $Y_i = 0$ (non-beneficiaries), holding all other covariates constant. An $RRR_{jk} < 1$ indicates a lower relative likelihood, while $RRR_{jk} = 1$ implies no association.

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B List of features

Table B1: List of features

Area	Feature	Measure	Description	Freq. S3	Freq. NRRP
Leadership	Programmer	Ministry	= 1 if programmer is a ministry	1,617	6,088
		Presidency of the Council (PCM)	= 1 if programmer is PCM	0	94
		Region	= 1 if programmer is the region	9,144	0
		Province	= 1 if programmer is the province	75	0
		Chamber of Commerce	= 1 if programmer is a CCIAA	665	0
		Private company	= 1 if programmer is a private company	23	0
Beneficiary	Single private	Private company, foundation, entrepreneur, private entity, freelance	= 1 if beneficiary is one private entity	9,534	9,169
	Single public	University, public entity, ministry, region, province, municipality	= 1 if beneficiary is one public entity	1,084	111
	Multiple public	Combination of multiple public entities	= 1 if beneficiaries are multiple public entities	64	302
	Private public	Combination of both private and public entities	= 1 if beneficiaries are multiple public and private	446	372

Continued on next page

List of features — continued

Area	Feature	Measure	Description	Freq. S3	Freq. NRRP
Activation	Activation procedure	Open call	= 1 if activation procedure is open call	9,651	1,920
		Direct allocation	= 1 if activation procedure is direct allocation	126	82
		Public Notice	= 1 if public notice	1,674	0
		Expression of interest	= 1 if expression of interest	1	3,726
		Negotiation Procedure	= 1 if negotiation procedure	77	4
		Financing law or decree	= 1 if financing law or decree	0	6,432
Complexity	Multiple beneficiary	-	= 1 if > 1 beneficiary	544	689
	Multiple territory	-	= 1 if project in multiple territories	484	312
	Multiple programmer	-	= 1 if project has multiple authorities	448	705
	Unique actor	-	= 1 if same actor is programmer and beneficiary	4,235	0
	Co-financing	Private-public partnership	= 1 if true	9,863	5,425

Continued on next page

List of features — continued

Area	Feature	Measure	Description	Freq. S3	Freq. NRRP
Project profile	Research and innovation	-	= 1 if research/innovation CUP	1,243	5,497
	Plants/facilities	-	= 1 if plants/facilities CUP	7,283	618
	Business support	-	= 1 if business support CUP	3,003	6,052
	High funding	-	= 1 if funding > mean	2,129	99
Context	Less developed	-	= 1 if less developed region	2,892	3,513
	Peripheral	-	= 1 if peripheral (inner area)	1,295	2,789
	Mayor education	-	= 1 if mayor has university degree	6,934	7,658
	Old mayor	-	= 1 if mayor > 65	797	646
	Young mayor	-	= 1 if mayor < 35	93	101
	High patent	-	= 1 if municipality in Q4 patent	2,704	2,478
	Low patent	-	= 1 if municipality in Q1 patent	2,906	3,320

Explanatory variables

Table B2: Covariates of interest in the multinomial logit

Dimension	Variable	Level	Source	Years
Economic activity	Income per capita	Municipal	MEF	2014-2023
	Entrepreneurship rate	Municipal	ISTAT	2014-2023
Territorial	Population	Municipal	ISTAT	2014-2023
	Urbanization level	Municipal	ISTAT	2014-2023
	Peripheral municipality	Municipal	ISTAT	2014-2023
	South & Islands	Regional	Eurostat	2014-2023
Innovation	n. patents	Municipal	Orbis	2015-2023
	n. pending patents	Municipal	Orbis	2015-2023
	n. granted patents	Municipal	Orbis	2015-2023
	Intangible assets	Municipal	Aida	2015-2023
Administration	Mayor age	Municipal	Ministry of Home Affairs	2014-2023
	Mayor tertiary education	Municipal	Ministry of Home Affairs	2014-2023

As discussed in the empirical strategy, covariates used in the empirical analysis are averaged over the period 2014–2023 to reduce the influence of short-term fluctuations and capture longer-term structural patterns. While this approach may smooth over temporary shocks, it allows for a more robust representation of underlying territorial differences.

Matching results

Table B3: Determinants of Non–Funding Status: Propensity Score Logit Model

	Coefficient	Std. Error
log _income	-0.978***	(0.051)
Population	-0.000066***	(0.000013)
Urbanization	-0.280***	(0.071)
Less developed area	0.225***	(0.067)
Peripheral	0.335***	(0.095)
Constant	16.987***	(0.969)
Observations	7,489	
Pseudo R^2	0.264	
LR χ^2	2734.47	
p-value	0.000	

Notes: Dependent variable = 1 if municipality did not receive funding. Logit model estimated before matching. Standard errors in parentheses. *** $p < 0.01$.

The propensity score model shows that observable pre-treatment characteristics strongly predict the likelihood of not receiving funding. Municipalities with higher average taxable income and larger resident populations are significantly less likely to be untreated, suggesting that wealthier and more urban areas were more likely to access funding. Conversely, being located in a "less developed area" or being a peripheral municipality significantly increases the probability of not receiving funding. The model displays good predictive power (Pseudo-R^2 = 0.264).

Dependent variable differences for machine learning

Table B4 confirms balance: $D_i = 1$ municipalities (inclusive cases) differ systematically from $D_i = 0$, allowing machine learning analysis of governance modes driving inclusiveness.

Table B4: Balance of Covariates Before Matching

	Group Means				
Variable	$D_i = 0$	$D_i = 1$	**Diff.**	**t-stat.**	**p-value**
Log Mean Income	19.077	17.483	1.594	45.28	<0.001
	(1.062)	(0.983)			
Population	28,358.3	4,667.3	23,691.0	11.28	<0.001
	(99,551.5)	(5,128.7)			
Urbanization	2.010	2.601	-0.591	-31.68	<0.001
	(0.539)	(0.527)			
South & islands	0.249	0.272	-0.022	-1.47	0.142
	(0.433)	(0.445)			
Peripheral	2.963	2.955	0.008	0.85	0.397
	(0.269)	(0.297)			

Notes: Standard deviations in parentheses. All tests are two-sample t-tests with equal variances.

Adaptive Procurement Manipulation under Varying Regulatory Thresholds: Evidence from Italian Municipalities Before and After a Natural Disaster

Giacomo Gazzellone

Abstract

Changes in regulatory design directly translate into public administrators' behavioural adaptation. This paper illustrates this mechanism by providing evidence that public buyers adjust their procurement strategies when regulatory thresholds change unexpectedly under emergency conditions. The analysis exploits the 2016 Central Italy earthquake, which introduced special rules raising thresholds for simplified procedures in affected municipalities. Using granular tender-level data from the Marche region (2014–2018) and combining coarsened exact matching, density discontinuity tests, and a triple-difference design, it finds robust evidence of strategic bunching: municipalities systematically allocate tenders just below ordinary thresholds in normal times and, after the earthquake, shift manipulation to the new emergency cutoff. The adjustment is concentrated in service contracts, while goods show weaker effects. Further, municipalities with a prior tendency to bunch sharply increase reliance on direct awards once thresholds were relaxed, indicating heterogeneous behavioural responses. These findings highlight that emergency provisions are not passively applied but strategically internalized, revealing a behavioural mechanism through which expanded discretion could translate into gaming the system and heightened governance risks.

Keywords: Public procurement, Disasters, bunching below thresholds.

JEL Classification: D73, H57

4.1 Introduction

Public procurement is a critical policy instrument through which governments transform public resources into infrastructure, essential services and goods required for the functioning of the public sector and the delivery of collective welfare. In advanced economies it accounts for a substantial share of total economic activity. For instance, in the European Union (EU) – excluding transactions by state-owned enterprises – it accounts for approximately 13% of GDP (Kutlina-Dimitrova and Cernat, 2020). Public procurement becomes even more important during emergency situations (crises and disasters) when "public spending typically increases to meet immediate needs, often at the expense of oversight"[1]: this explains the growing worldwide attention of to the design of procurement-process regulation, considering the increasing incidence of catastrophic and unpredictable events (European Commission, 2020; UNODOC, 2024). In detail, the design of regulation shapes administrative behaviour by defining what is legitimate, expected, and rewarded. At the same time, rules trigger bureaucratic practices' strategic adaptation which might be put in place to preserve discretion, secure practical or reputational advantages or reduce exposure to risk, effort, and sanction. Given its scope and scale, the design and governance of procurement have significant implications for public sector efficiency and accountability. On the one hand, the integrity of procurement processes constitutes a cornerstone of effective public administration and sound fiscal governance (Siyal and Xin, 2022; Grandia, 2017; Philips et al., 2012). On the other hand, integrity in procurement cannot be safeguarded without acknowledging the role of discretion, which is essential for adapting procedures to complex and evolving needs. Yet, the features that make procurement flexible and responsive – i.e., that allow procedural discretion – also expose it to significant vulnerabilities such as inefficiencies, discretionary abuse, and corruption risks (Decarolis et al., 2021; Cavalieri et al., 2025). Consequently, a growing body of empirical research has sought to determine whether and under what institutional conditions discretion translate into governance failures.

A key institutional mechanism that structures discretion within procurement systems is the use of contract value thresholds (Molander, 2014). From a theoretical perspective, procurement thresholds are designed to balance two objectives: on the one hand, reducing administrative and transaction costs by allowing simplified procedures – such as restricted tenders or direct awards – for contracts below threshold (i.e., those with more limited value); on the other hand, ensuring accountability and integrity by requiring more transparent, competitive, and closely monitored

procedures for contracts above-threshold where risk of favouritism, collusion and rent-seeking is higher is presumed to be higher which justifies higher administrative complexity and higher administrative costs (Palguta and Pertold, 2017). In this context, adjusting contract values to remain just below the threshold (i.e., bunching below threshold) can constitute a strategic behaviour, enabling contracting entities to circumvent more complex, competitive and scrutinized procedures. While such behaviour may be driven by legitimate concerns – such as accelerating procurement under urgency or reducing transaction costs, it may also reflect opportunistic motives, including favouritism, rent-seeking, or efforts to evade oversight.

Identifying whether contracting authorities engage in such strategic adjustments remains an open empirical challenge. A growing body of literature has investigated this issue by detecting discontinuities in the distribution of tenders' values around procedural thresholds (Bobilev et al., 2015). While these analyses are highly informative, they are primarily descriptive in documenting a potentially suspicious pattern. Indeed, they cannot establish whether the concentration of tenders just below the threshold is caused by the threshold itself, as it may instead reflect underlying factors, e.g. demand characteristics, market conditions, etc..

Within this framework, regulatory reforms that alter applicable thresholds offer a valuable opportunity to study the behavioural response of procurement agents. Indeed, plausibly exogenous threshold changes allow researchers to isolate the causal effect of expanded/reduced discretionary space on the emergence of bunching below threshold – that is, to assess whether the observed concentration of tenders just below the new cutoff reflects a strategic response to the change in rules, rather than other confounding factors.

Recent papers rely on this identification strategy to study bunching below thresholds. Palguta and Pertold (2017) examine the case of a 2006 reform in the Czech Republic that introduced new thresholds for simplified procurement procedures. They find evidence of bunching below these new cutoffs right after the legal change, which suggests a causal link between threshold design and public administration's strategic adjustment. Similarly, Coviello et al. (2018, 2022) exploit threshold discontinuities in the Italian context to test how discretion interacts with governance quality and emergency conditions. Adding to this evidence, Szűcs (2024) analyses the Hungarian 2011 reform showing that increased discretion leads to worse procurement outcomes.

In contrast to these studies that leverage planned regulatory reforms, other contributions exploit expanded discretion in public procurement resulting from natural disasters exogenous shocks. Building on descriptive insights on the Italian case from Coviello et al. (2021), Fazekas et al. (2025) show that, during emergencies – when special procurement rules are activated that effectively expand discretionary power – Italian disaster-affected areas experience a significant rise in the use of non-competitive procedures and "red flag" indicators which can be employed to assess the risk of corruption in the public procurement (Fazekas et al., 2016). By focusing on several outcomes of increased discretion, Fazekas et al. (2025)'s contribution offers compelling evidence on how flexibility under emergency conditions can inadvertently foster corruption risks. The novelty of our work lies in its focus on a specific red-flag indicator – namely, bunching below the threshold – through which we provide a more in-depth analysis of contracting authorities' behaviour by examining how these latter strategically manipulate contract values to remain below the emergency regulatory thresholds, thereby enabling the use of less transparent procedures. In other words, while earlier contributions demonstrate that increasing discretion during the emergency translates into concerning outcomes, they leave unaddressed how this discretion is operationalized in dept. This paper addresses this gap by focusing explicitly on threshold manipulation during emergency periods. We open the "black box" of public actors' behaviour in launching tenders, uncovering not only a "red flag" but also an adaptive strategic behaviour whereby administrations adjust tender amounts to exploit the advantages of the newly altered tendering conditions made possible by the emergency, to access more flexible and discretionary procedures such as direct awarding.

Our analysis exploits a quasi-experiment setting generated by the 2016 Central Italy earthquake, which prompted the adoption of exceptional legislative provisions that raised the thresholds for simplified procurement procedures in the affected municipalities. In total, 137 municipalities across four central Italian regions (Marche, Lazio, Umbria, and Abruzzo) were shocked by the earthquake. Among these, 85 municipalities – 62% of the total affected – were in the Marche region, representing 36% of all municipalities in that region. This regional concentration allows us to implement a quasi-experimental design with a sizable number of both treated (affected) and untreated (unaffected) municipalities within the same institutional, economic and cultural regional context. Therefore, our analysis relies on contract-level data and includes 28,001 tenders covering all the procurement activities localized in the Marche municipalities in the years 2014-2018, spanning both the pre- and post- earthquake period.

In the first part of the analysis, we adopt an econometric design based on a combination of coarsened matched sampling - to identify similar treated (shocked by the earthquake) and untreated (not shocked by the earthquake) municipalities' pairs - and nonparametric density estimation. The latter enables us to test for discontinuities in the distribution of procurement amounts around regulatory thresholds, following the methodology developed by Cattaneo et al. (2020). This approach closely follows the methodology used by studies on threshold manipulation in normal times, such as Coviello et al. (2018, 2022) and Palguta and Pertold (2017). However, our contribution extends the existing literature by situating the analysis in an experiment-like setting in which the relevant regulatory thresholds change exogenously, thanks to the introduction of urgency threshold which allow, exclusively disaster-hit municipalities, to directly award contracts below 200,000 euro (art. 163 D.Lgs 50/2016). While procurement needs may also shift because of the disaster, the sharp discontinuities observed precisely at the new legal cutoffs provide empirical support for the idea that municipalities strategically adapted their behaviour, rather than merely responding to broader demand-driven changes in procurement activity. We test the robustness of our findings through a variety of additional analyses including placebo-testing.

In the second part of the analysis, we employ a triple-difference (difference-in-difference-in-differences, or DDD) strategy to test whether the observed bunching behaviour actually translates into a greater use of simplified and more discretionary procedures, particularly direct awards. This method allows us to compare procurement outcomes across time (pre- and post-earthquake), across contract value ranges (below and above the urgency threshold), and across procedure types (direct award vs other procedures). This triple comparison helps circumvent the problem of selection bias which may arise in the context of discretionary public procurement (Szucs, 2024). By leveraging the earthquake occurrence and value threshold jointly, the triple-difference design enables credible identification of the causal impact of discretion on increased reliance on direct awards – separating it from non-random sorting and common shocks over time.

All the analyses are conducted separately for services and goods tenders, allowing us to explore whether these two different procurement categories respond differently to the same institutional incentives. Works are not considered because they are subject to a different set of thresholds.

Our findings firstly document that in ordinary (non-emergency) periods, contract values systematically bunch just below the applicable statutory thresholds. Then we document that the

earthquake-affected municipalities adapted their procurement strategies by systematically allocating tenders just below the "new" emergency threshold while the same is not observed in their counterfactual counterparts. This specifically happens for services while the evidence for goods is mixed. In other words, our results suggest that at least for services there is a discontinuous response emerging only in treated areas and in close correspondence with the threshold change, which supports the idea that public buyers engage in active strategic adjustment in response to expanded discretionary margins. DDD analysis further shows that following the emergency decree that raised direct award thresholds, municipalities with a history of bunching contract values just below the limit sharply increased their reliance on direct awards, unlike other treated municipalities. This indicates that the reform's impact was particularly concentrated on this strategically behaving subgroup.

This paper contribution is twofold. On the one hand, it adds to the already mentioned literature on procurement. While previous research has shown that emergencies expand discretion and increase corruption risks (Fazekas et al., 2025), and that public buyers bunch below thresholds in normal times (Palguta and Pertold, 2017; Coviello et al., 2018), this paper bridges these different strands by documenting that contracting authorities strategically realign bunching behaviour to newly introduced emergency thresholds. While our analysis does not assess procurement outcomes (i.e., in terms of corruption risk) directly, it sheds light on the behavioural foundations of corruption risk. Indeed, our findings suggest that the regulatory thresholds introduced to expedite procurement during emergencies, i.e., rules intended to "streamline" emergency procurement, are not passively applied, but actively internalized and strategically instrumentalized by contracting authorities.

On the other hand, this paper adds to the broader literature on disasters and corruption, which highlights how extreme events can change ordinary governance arrangements and weaken accountability mechanisms (Farazmand et al., 2022).

The structure of the paper is as follows. Section Two reviews the general literature on public procurement as well as the specific strand addressing procurement in times of disasters and positions the contribution of this paper within these debates. Section Three describes the system of procurement thresholds in place in Italy during the years covered by our analysis. Section Four sets the stage for the empirical investigation by presenting key information on the 2016 earthquake that struck central Italy – an event we exploit as a source of exogenous variation in procurement regulation, due to the emergency thresholds introduced in its aftermath – and by

introducing the Marche region, whose municipalities' procurement activities are observed in our dataset. Section Five provides a detailed overview of the data. Section Six outlines the empirical strategy and methods employed. Section Seven presents our main results, distinguishing between the pre- and post-earthquake periods. Section Eight reports extensive robustness checks. Finally, Section Nine concludes.

4.2 Background Literature

In recent years, empirical research on public procurement has gained significant momentum, partly due to the increasing availability of high-quality administrative data at the contract level. This growing empirical literature has mainly converged around two main objectives. First, investigating whether public buyers engage in strategic behaviour by adjusting contract values to remain just below regulatory thresholds that allow more discretionary and less transparent procurement procedures. Bunching below the threshold is considered a red-flag indicator of corruption risks, signalling potential manipulation during the publication of a tender (Fazekas et al., 2016). Second, assessing the consequences of such discretion/opacity, testing whether they lead to worse outcomes in terms of efficiency and corruption.

In both strands of research, the main empirical challenge lies in the non-random assignment of procurement procedures. This issue affects not only studies that aim to identify the causal effects of discretion, but also those focused on documenting bunching behaviour. Indeed, the observed concentration of contract values just below regulatory thresholds may reflect not only strategic manipulation by public buyers, but also underlying differences in project characteristics, administrative capacity, or political incentives.

As a result, even descriptive analyses of bunching are potentially misleading if they lack a credible counterfactual. In the absence of exogenous variation in the assignment of procurement procedures it is difficult to rule out alternative explanations for the observed distribution of contract values. Such exogenous variation is essential to establish whether the bunching reflects opportunistic behaviour or instead results from unobserved heterogeneity in procurement needs or contexts.

Part of the literature offers valuable descriptive evidence but does not explicitly address the endogeneity of procedural choice, trying to identify the causal effects of discretion. For instance, Bobilev et al. (2015) analyse Swedish procurement data from 2009 to 2013 (n ~ 97,000), extracted from the Visma Commerce AB database. Using both descriptive statistics

and the McCrary (2008) density discontinuity test, they document a notable concentration of tender values just below regulatory thresholds – an indication suggestive of potential strategic behaviour, though not conclusively attributable to it.

Tas (2023) analyses the European Union public procurement data including more than two million contracts. He uses a regression discontinuity manipulation test developed by Cattaneo et al. (2020a) to identify authorities that manipulate the estimated costs of contracts to be just below the EU thresholds and finds that 10–13% of the examined authorities exhibit a high probability of strategic bunching. In addition, he finds that manipulation translates into lower competition, higher probability of winning local and incumbent firms.

By contrast, other studies attempt to address this endogeneity by exploiting exogenous sources of variation – such as regulatory discontinuities or natural disasters – that plausibly alter the scope for discretion in procurement procedures.

Shifting to single-country analyses, Palguta and Pertold (2017) use a large contract-level dataset of procurement contracts awarded in 2005-2010 in Czech Republic (n~46,000). They apply non-parametric density estimation techniques and the density test described by McCrary (2008) to compare the distribution of procurement values before and after a 2006 national reform that introduced new discretionary thresholds in public procurement law. They document the emergence of bunching just below the threshold after the reform – absent before – which suggests manipulation induced by the new legal discretion.

Szucs (2024) analyses the case of the public procurement policy reform enacted in Hungary 2011 which allowed more discretion and less competition in awarding public tenders whose value was below a certain threshold. Using data on all Hungarian procurement contracts awarded in the 2009–2015 period (n~48,000) he documents that right after the reform the share of tenders below the threshold authorizing high-discretion tenders increased substantially. Then he applies a regression discontinuity design (RDD) around the new threshold to detect behavioural changes in procurement outcomes. Finally, recognizing the potential manipulation of contract values around the threshold, he complements the RDD with a structural Roy model that leverages the reform's timing. His findings provide evidence that procurement outcomes were less favourable in the case of tenders below the threshold.

Multiple works investigate the case of Italy. Coviello et al. (2018) examine Italian construction works auction data from 2000 to 2005, focusing on contracts valued between €200,000 and

€500,000 (n~3,300). They show that contracting authorities tend to exercise greater discretion when permitted by the Italian national regulatory framework: approximately 7% of the auctions under scrutiny employed restricted competition procedures (*Trattativa Privata*), predominantly for contracts below €300,000 – the regulatory threshold that eases access to these less competitive procurement rules. Using a regression discontinuity design (RDD), the authors compare procurement outcomes just above and below this regulatory threshold and find no evidence that increased discretion adversely affects procurement performance. In a different paper using the same data, Coviello et al. (2022) rely on "density discontinuity" techniques and LASSO analyses to document that bunching around discretion-reducing thresholds more frequently happens when the auction is managed by appointed bodies compared with elected ones, and confirm that it has mixed effects on prices, and positive effects on ex-post outcomes. This analysis also demonstrates that appointed administrations strategically adjust to the 2006 procurement reform which in 2006 shifted down the discretion-reducing thresholds. Finally, another contribution by Coviello et al. (2021), based exclusively on road works procurement data, provides descriptive evidence that the strategic manipulation of contract values to remain below discretion-reducing thresholds is more frequent in regions affected by a natural disaster (the 1997 earthquake that hit Umbria and Marche in Central Italy).

This finding is consistent with insights from the literature examining the fiscal consequences of natural disasters. Emergencies tend to alter local authorities' spending behaviour, leading to a rapid increase in public expenditure and investment in the aftermath of the shock (Masiero and Santarossa, 2020). Moreover, the urgency imposed by such events often requires expedited procurement processes, which may bypass conventional oversight mechanisms and thereby increase the risk of inefficiencies and corruption (Schultz and Søreide, 2008). As noted by Aguirre and Lane (2019, p. 4), "disasters can trigger the emergence of criminal opportunities as individuals, communities, and organizations respond to changing social conditions brought about by the disasters.

Following this vein, Fazekas et al. (2025) investigate how natural disasters influence corruption risks in public procurement by analysing approximately 393,000 tenders awarded by Italian contracting authorities between 2007 and 2020, using data from the Tenders Electronic Daily (TED). They focus on five major disasters – earthquakes and floods – that occurred between 2009 and 2017, and identify tenders awarded by municipalities located in the disaster-affected areas (n ~ 11,000). These disasters serve as plausibly exogenous shocks that activated

emergency provisions which de facto increased discretion for local officials – for instance, by allowing for direct awards or limited tenders with fewer transparency requirements even for tenders whose value exceeds 1 million euros. The authors exploit this variation by comparing disaster affected and unaffected areas before and after each disaster. Using logistic regressions, coarsened exact matching, and difference-in-differences estimators, they show that, following disasters, municipalities in affected areas are significantly more likely to use non-open procedures, to publish tenders with shorter advertisement periods, and to award contracts with only a single bidder – all of which are considered "red flags" of corruption risk. Thus, rather than testing manipulation around thresholds, the study shows that disaster exposure is connected with a shift toward less competitive procurement in emergency contexts.

This study builds on and complements the approach developed by Fazekas et al. (2025). While they use disaster exposure as an exogenous shock to buyer discretion and document adverse outcomes via a treated/untreated pre-post comparison, they do not formally examine bunching below thresholds as the mechanism driving this outcome. By contrast, the design adopted in the present study exploits in an explicit way the institutional mechanism that allows this result: the formal revision of procurement thresholds for municipalities affected by the 2016 earthquake in Central Italy and municipalities' strategic adaptive behaviour. This creates a clearer and more legally codified source of variation in available discretion. Whereas Fazekas et al. (2025) treat the disaster shock as a binary treatment, the current design allows for additional within-group variation, since municipalities could choose whether or not to adopt the emergency threshold. This two-stage structure – exogenous eligibility combined with endogenous uptake – enables a richer analysis of both the effects of expanded discretion and the conditions under which it is strategically used. In this sense, the paper refines the identification of discretion's causal effects, offering a contribution that is both conceptually and empirically complementary to existing disaster-based studies.

4.3 Thresholds in the Italian Procurement Law

Between 2014 and 2018, the period under scrutiny in this analysis, procurement regulation ("Public Procurement Code") transitioned from Legislative Decree No. 163/2006 to Legislative Decree No. 50/2016 which entered into force in April 2016, transposing EU Directives 2014/23, 2014/24, and 2014/25. The Legislative Decree No. 50/2016 experienced later updates of which only one was in force during our period of analysis (Legislative Decree No. 56/2017)[2].

As clarified by the Italian Parliamentary Budget Office (UpB, 2019), with the 2016 Code, the legislator aimed to reorganize the entire sector of public procurement and concessions through a single act and a systematic approach, following international best practices and in line with the principles of the most recent economic literature on procurement, albeit with numerous uncertainties, inconsistencies, and revisions. The necessity to issue a composite code was deemed necessary in the light of the economic role of public procurement which accounted for 10.5% of GDP over the period 2012–2015, of which approximately 78% related to goods and services, and the remaining 22% to investments (Peta, 2017, p. 2). Interesting to note that this latter author, albeit with reference to works for data availability, evidences that the structural composition of public works demand was characterized by high degree of fragmentation both in the value as well as its distribution by type of administration, as approximately 92% of the procedures launched in 2015 fell within the lower value brackets and with around 70% of procedures (36% in terms of economic value) attributable to contracting authorities belonging to the category of local authorities and, in particular, to the municipal sector (59% of the number of tenders issued, corresponding to 26% of the total economic value of the amounts put out to tender) (Peta, 2017, pp. 7-8).

The procedures available to contracting authorities are determined by value thresholds varying by contract type (works, goods, or services), by the nature of the contracting authority (central vs. sub-central), and by whether the procurement occurs under ordinary conditions or during a formally declared state of emergency. These thresholds define when simplified procedures (such as direct award or negotiated procedure) may be used, and when more formalized competitive procedures (e.g., open or restricted tender) become mandatory. The value of these thresholds evolved significantly across time, preventing a clear-cut definition and resulting in a rather puzzling implementation.

In the following description, we concentrate on two set of thresholds for goods and services set by the Legislative Decree No. 50/2016: the first concerns specific emergency reasons, called emergency procurement threshold under the "*istituto di somma urgenza*", set to 200,000 euro, and a second set of thresholds which, instead, can be applied in ordinary times. The very difference between the two thresholds, "*istituto di somma urgenza*" /emergency threshold and normal time thresholds, which are very close in terms of amount, lies in the selection of the economic operator: the emergency institute allows for the direct award of the operator, while

the normal time thresholds require a negotiated procedure with the selection of at least 5 operators. In detail, under the "*istituto di somma urgenza*[3]", the rules presented in Table 1 apply.

Table 1: Evolution of emergency procurement thresholds and procedures for goods and services in Italy (2014–2018)

Period	Contract Type	Threshold Range (€)	Main Legal Basis	Assignment Procedure
2014-2015	Works, Services, Goods	No fixed threshold (flexible case-by-case)	Legislative Decree No. 163/2006, Art. 57(2)(c) + Art. 176(4)	Negotiated procedure without prior publication allowed in cases of extreme urgency. The concept of 'somma urgenza' existed, but not with a fixed €200,000 threshold. Applied with more discretion and local variation, on a case-by-case basis
2016–2018	Services, Goods	≤ 200,000	Legislative Decree No. 50/2016, Art. 163	Direct award in case of extreme urgency due to unforeseeable events (e.g., disasters, public safety). Allowed only for essential, immediate measures. Must be formalized ex post.

Leaving aside public works as they were subject to a different set of thresholds[4], for services and goods thresholds in normal circumstances varied from 207,000 to €209,000 between 2014 and 2016 and were valid for local and sub-central authorities (Legislative Decree No.163/2006, Art. 125 and Legislative Decree No. 50/2016, Art. 35 (1) (c) 36(2)(b) respectively).

During the 2014–2018 period, the normal time thresholds for local administrations' tenders concerning goods and services were those illustrated in Table 2.

Table 2: Evolution of normal time procurement thresholds and procedures for goods and services in Italy (2014–2018)

Period	Contract Type	Threshold Range (€)	Main Legal Basis	Assignment Procedure
2014–2015	Goods and Services	<207,000	Legislative Decree No.163/2006, Art. 125	Simplified Negotiated procedure ("in economia") with invitation to at least 5 economic operators.
2016–2018	Goods and Services	<209,000	Legislative Decree No. 50/2016, Art. 35 (1) (c) 36(2)(b)	Negotiated procedure without prior publication, with invitation to at least 5 economic operators.

As the tables confirm, the two set of thresholds are very close: the proximity of the thresholds will allow us to study the adaptive behaviour of local authorities in selecting the threshold - and consequently the related procedure - to apply. It is worth remarking that the "istituto di somma urgenza" (emergency procurement regime) - unlike the ordinary €207,000–€209,000 thresholds applicable in non-emergency periods - allows a direct award rather than a negotiated procedure, thereby materially increasing the contracting authority's discretion.

By focusing on local administrations during a period of stable and clearly defined threshold rules, our study exploits the exogenous institutional shock of the 2016 Central Italy earthquake to analyse how contracting authorities adapted their procurement strategies in response to both the emergency context and the available procedural flexibility. In particular, we assess whether buyers exhibited signs of strategic bunching – concentrating contract values just below applicable thresholds – and whether such behaviours became more pronounced under the emergency derogations that expanded discretionary power. From now on, the services and goods thresholds described will be referred to as Threshold A and Threshold B, as follows:

- Threshold A: threshold for simplified procurement in normal times. This threshold value was €207,000 in 2014 and 2015 while it increased at €209,000 in 2016. Tenders under these thresholds could activate negotiated procedures involving only the consultation of five economic operators.
- Threshold B: Emergency procurement threshold introduced in case of emergency: €200,000. For goods and services provisions under this threshold, public administrations operating in emergencies could select a contractor without conducting consultation of public tender.

Overall, these thresholds provide a sharp discontinuity in the institutional environment that can be exploited to detect behavioural responses by procurement officers.

4.4 Empirical Context: the Marche Region and the 2016 Central Italy Earthquake

4.4.1 The Marche region

The Marche region has 5 Provinces, 9 Mountain Unions, and 225 Municipalities. It covers 9,344 square kilometres, with a population density of 159 inhabitants per square kilometre. As of January 1, 2024, the resident population amounted to 1,482,746 individuals, distributed across provinces as follows: Ancona with 461,629 inhabitants (31.1%), Pesaro and Urbino with

349,882 (23.6%), Macerata with 302,993 (20.4%), Ascoli Piceno with 200,897 (13.5%), and Fermo with 167,345 (11.3%). As of December 31, 2023, there were 135,205 active businesses, accounting for 2.7% of all businesses nationwide (Regione Marche, 2025). Between 2008 and 2023, the economy of the region performed worse than the national average. By the end of this period, the region's added value remained 5 percentage points below its 2007 level. Despite an increase in the employment rate (from 69.4% to 74.0%), the decrease in labour productivity as well as in the resident population (-2.2% in the time period examined) negatively affected the region's economy (Banca d'Italia, 2025). From 2010 to 2023, the quality of governance in the region has improved, though to a lesser extent than in the macro-area (Centre of Italy) and the national average, due to low levels of transparency, lower citizen trust in local governments, and lower efficiency and integrity of institutions (Banca d'Italia, 2025).

Marche is characterized by various forms of environmental vulnerability. As reported by Banca D'Italia (2025), nearly 3 percent of the regional surface area (mostly at the intersection between the coastal strip and the region's main rivers) is classified as being at medium-high flood risk (where 5 percent of the population is located). Also high landslide risk affects about 8 percent of the regional territory and primarily involves municipalities near the Apennine range (correspondent to 2 percent of the population). Despite a preventive implementation of land management works aimed at increasing territorial resilience[5], the permanent sealing of soil, which is particularly high in the region (relative to the population, land sealing rate has increased more than the national average between 2006 and 2023 and was greater in municipalities with a high hydrogeological risk profile) is considered a factor which may exacerbate the consequences of extreme events (Banca d'Italia, 2025).

Local authorities are responsible for several tasks in managing emergency situations caused by extreme events, including: the preparation of intervention plans, the organization of disaster response, and the coordination of rescue efforts. The most severe meteorological events trigger the declaration of a national state of emergency by the Civil Protection and the opening of special accounts at the State Treasury, managed by the Delegated Commissioner in charge of resource administration. "Between 2013 and 2024, the Marche Region received a total of €500 million through these special accounts, of which about one-third had been spent by the end of the period" (Banca d'Italia, 2025, p. 57). Environmental vulnerability, the 2016 earthquake, governance issues and bottlenecks coupled with the significant increase in resources allocated to the region, as well as its almost immediate spending capacity, make the Marche region a

particularly interesting case study for examining the link between public procurement and natural hazards.

4.4.2 The Central Italy Earthquake in 2016

The 2016 central Italy seismic sequence consisted of a series of moderate-to-large earthquakes caused by normal faulting along the Apennine Mountain chain. This sequence affected areas located at the intersection of four central Italian regions: Lazio, Umbria, Abruzzo, and Marche. The seismic activity spanned a period from August 24th, 2016, to January 18th, 2017 (Mollaioli et al., 2019).

Over the entire period, the Italian National Institute of Geophysics and Volcanology (Istituto Nazionale di Geofisica e Vulcanologia – INGV) registered nine seismic events with magnitude greater than 5.0 MMS (source: INGV official earthquake list, http://www.ingv.it). The sequence unfolded through four major seismic events. The first occurred on August 24th, 2016, when a magnitude 6.0 earthquake on the Moment Magnitude Scale (MMS) struck with an epicenter situated between the regions of Lazio and Marche. A second significant event took place on October 26th, involving two closely linked shocks of magnitude between 5.5 and 5.9 MMS, with epicenters located between Umbria and Marche. The third, and most catastrophic, event was recorded on October 30th: a magnitude 6.5 MMS earthquake whose epicenter was located in the Umbria region. Finally, on January 18th, 2017, a new sequence of four strong tremors struck the Abruzzo region, the most powerful of which reached a magnitude of 5.5 MMS.

Overall, the seismic sequence resulted in approximately 300 fatalities and displaced over 40,000 people. It affected 137 municipalities across the four already mentioned central Italian regions. Most of these municipalities (n=85) were in the Marche region.

4.5 Data

The analysis relies on granular data on public procurement tenders awarded by Italian municipalities in the Marche region over the 2012–2019 period, drawn from the open-source dataset developed and maintained by the Italian National Anti-Corruption Authority (ANAC). For each tender, the database provides information describing its object and variables observing the procurement type (goods, services and works), the tender value and the year when it was awarded, the procedure used to assign the contract and the municipality where the tender was carried out. A data cleaning process was carried out to retain only valid observations by excluding tenders that have a negative monetary value. After this cleaning, the dataset includes

80,482 tenders, of which 48.82% concern goods, 19.06% works and 32.12% services. To ensure comparability over time – given the issues highlighted in the literature regarding multiple threshold changes in the Italian Public Procurement Code – the analysis is restricted to the 2014-2018 period. This yields a refined dataset of 28,001 tenders, with 48.93% for goods, 21.93% for works, and 29.14% for services.

Figure 1 shows the total number and total value of tenders awarded by the Marche municipalities in the 2014-2018 time span. The Figure shows that the number of tenders remained relatively stable from 2014 to 2016, followed by a marked increase in 2017 and 2018, peaking at over 10,000 tenders in the final year. In contrast, total contract values rose more steeply between 2015 and 2017, reaching a maximum in 2017 before declining in 2018. This divergence suggests that while procurement activity intensified in terms of volume, the average value per contract may have decreased in the final year, potentially reflecting a shift toward smaller-scale projects or greater fragmentation of procurement lots.

Figure 1: Public procurement tenders in municipalities of the Marche region – annual number of tenders and total contract values (2014–18)

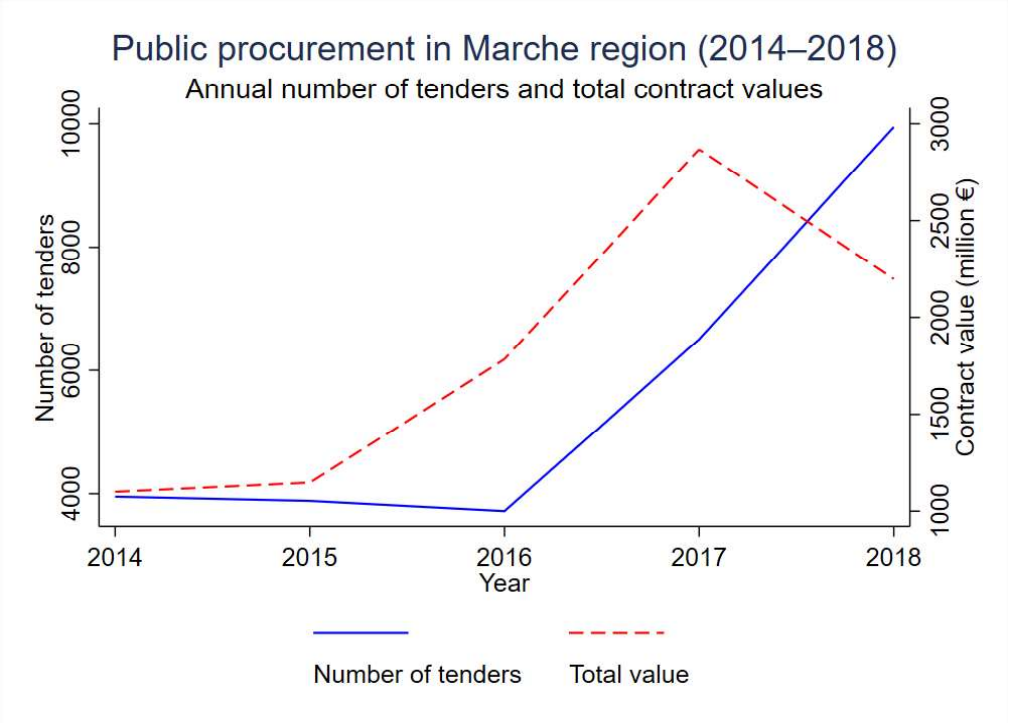
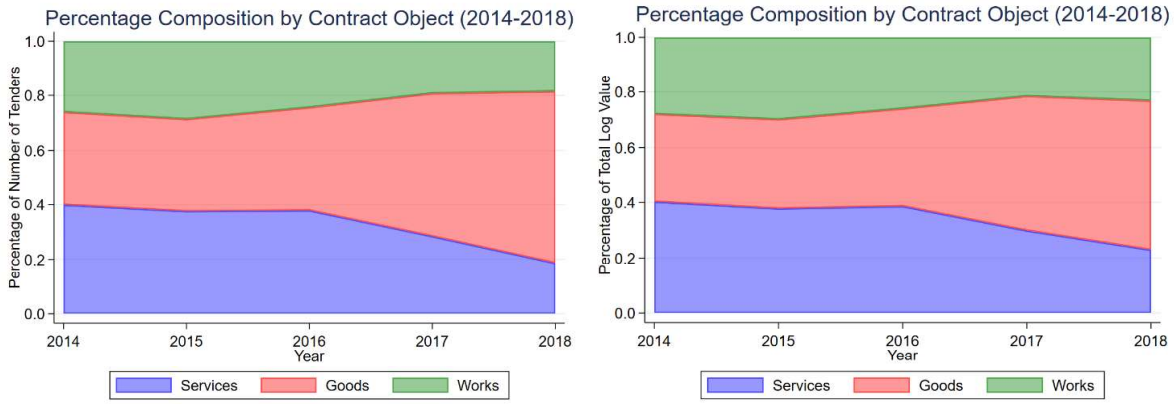


Figure 2 displays the composition of total public procurement contracts awarded by municipalities in the Marche region over the 2012–2019 period, along with the corresponding total annual values (in logarithmic scale), disaggregated by procurement object: works (green),

services (purple), and goods (red). Both figures suggest that the 2016 earthquake had a substantial impact on the composition of procurement. In the years following the disaster, the share of tenders awarded for works and services decreased sharply, while the incidence of procurement for goods increased significantly. This shift is particularly evident in the value-based graph, indicating that not only the number but also the financial weight of contracts for goods rose. Such a pattern likely reflects the reallocation of resources toward the immediate purchase of equipment and supplies required for emergency response and recovery, possibly at the expense of more complex and time-consuming service provision or infrastructure projects.

Figure 2: composition of public procurement contracts in municipalities of the Marche region 2015-18: number of tenders and total value by object.



Particular attention is devoted to the sectoral composition of works, goods, and services. Descriptive statistics reveal a pronounced increase in the average amount of funding allocated to services following the 2016 earthquake, while the rise in funding for goods and works is comparatively modest. Notably, in 2014 and 2015, the control group exhibited a higher mean level of service funding than the treated group. However, after the 2016 event, the treated group's mean funding for services more than doubled that of the control group and remained approximately twice as high in both 2017 and 2018. This pattern does not extend to goods and works, for which average funding levels remain broadly similar across treated and control groups over time. Nonetheless, a modest post-disaster increase is observed in both categories: following the event, tenders for goods are approximately 36 percent and 75 percent more expensive in treated municipalities in 2016 and 2017, respectively, while tenders for works are about 11 percent and 31 percent higher over the same years. Beyond the sharp post-disaster surge in service funding, the data reveal pre-treatment parity between treated and control municipalities in services but not in goods, heterogeneous timing of post-shock adjustments

across sectors, and a decline in control-group funding after 2016 – consistent with a targeted, time-staggered reconstruction response.

Table 3 – Mean amount of tender value for type of contract between 2014 and 2018

Mean amount tender value		2014	2015	2016	2017	2018
Services	**Control**	311.906,80 €	319.016,30 €	350.230,30 €	214.386,80 €	185.597,80 €
	Treated	183.445,00 €	298.825,80 €	785.123,60 €	527.731,80 €	328.648,80 €
Goods	**Control**	95.246,27 €	125.315,60 €	216.258,70 €	157.907,60 €	256.874,80 €
	Treated	137.766,50 €	287.872,00 €	294.652,10 €	275.009,70 €	248.783,10 €
Works	**Control**	202.983,60 €	270.514,20 €	229.281,20 €	250.657,80 €	189.011,30 €
	Treated	166.451,90 €	205.805,90 €	255.676,90 €	328.419,60 €	158.159,30 €

Figure 3 – Mean amount of tender value for services between 2014 and 2018

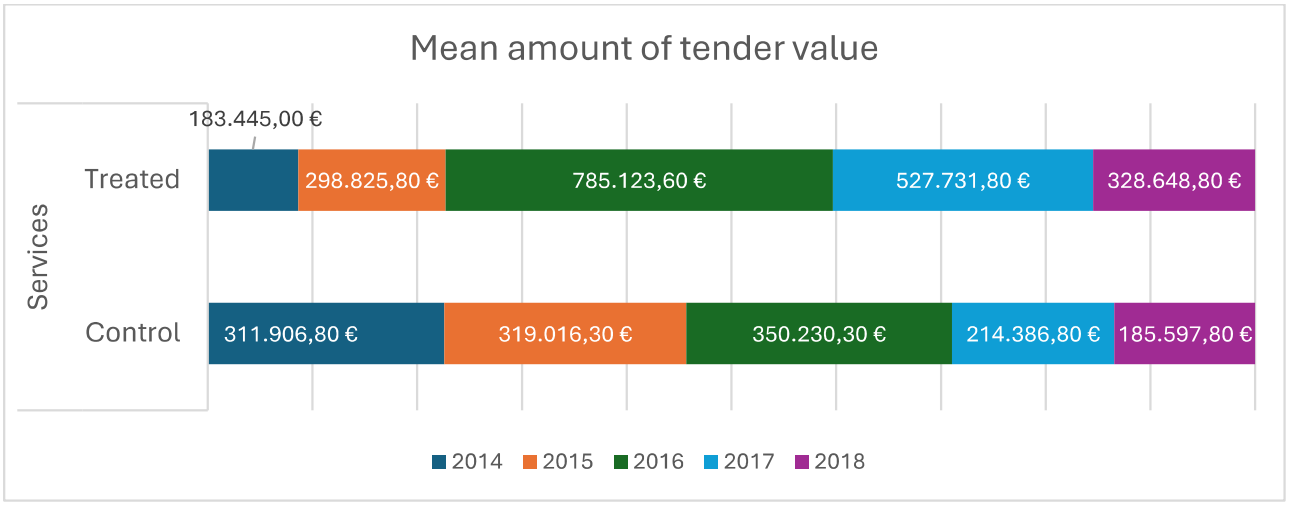


Figure 4 – Mean amount of tender value for goods between 2014 and 2018

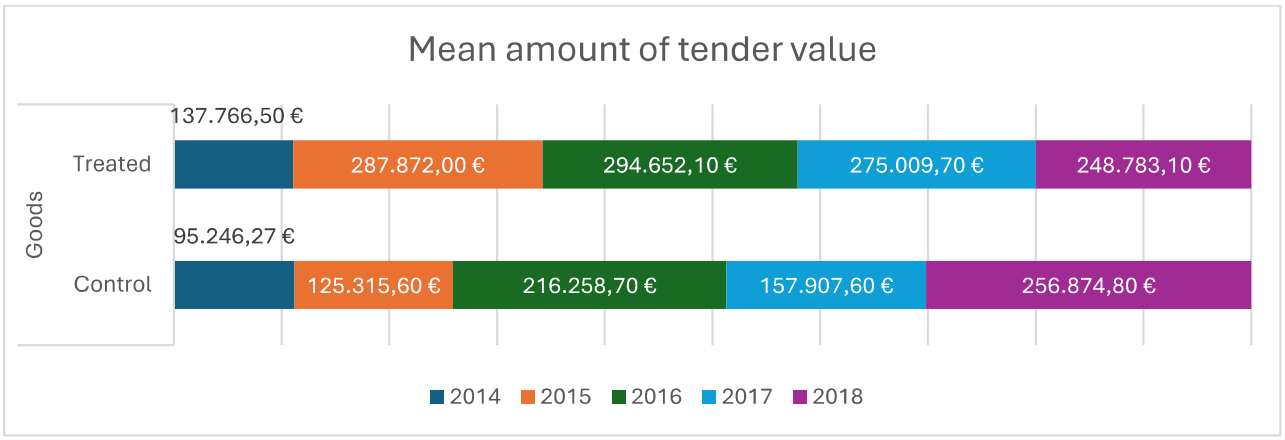
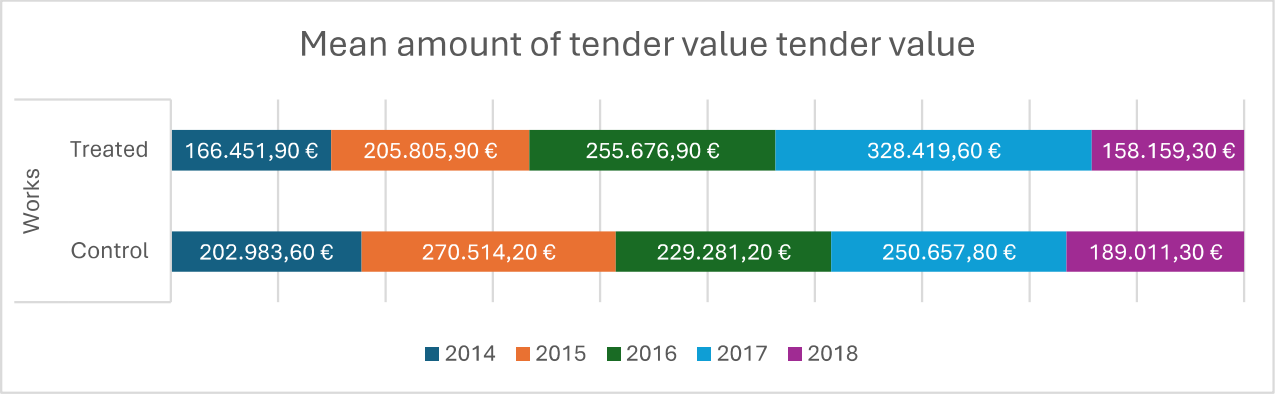


Figure 5 – Mean amount of tender value for works between 2014 and 2018



These differences highlight the importance of examining service provision before and after the event. Tables C1 and C2 in the Appendix present the detailed sectoral composition of services, classified according to the Common Procurement Vocabulary (CPV), which identifies the specific area of intervention, for procurement contracts issued in both affected and control municipalities.

In the following, the analysis is focused on the data that concern goods and services. As already highlighted in Section Three, we concentrate on the threshold set by the Legislative Decree No. 50/2016 for specific emergency reasons (the "istituto di somma urgenza" thresholds) which are valid for goods and services. We left aside public works as they were subject to a different set of thresholds.

4.6 Empirical Strategy

The disaster plays a central role in our identification strategy: by exogenously and unexpectedly altering access to simplified procurement procedures, it randomized the assignment of Marche municipalities to different levels of discretionary space in public procurement. This quasi-experimental setting is particularly well-suited to studying behavioural responses to changes in regulatory thresholds. Based on official declarations of emergency and inclusion in post-disaster reconstruction zones[6], we classify 85 Marche municipalities as treated, having been directly affected by the seismic events that occurred in the region between August and October 2016 and therefore subject to the emergency regulatory regime. Instead, the remaining municipalities in the region (n=154), which were not affected by the earthquake, serve as the untreated comparison group.

4.6.1 Matching

Given the presence of structural heterogeneity between treated and untreated municipalities, direct comparisons may lead to biased estimates. To ensure comparability across groups, we applied the Coarsened Exact Matching (CEM) imbalance-reducing matching method. This method is based on the principle of recoding all relevant continuous covariates into discrete categories and then identifying treated and control units that fall within the same strata across all these coarsened variables (Iacus et al., 2012; 2019). The matching procedure was implemented using the *cem* command in Stata. To define the coarsening cut points (bins), the Scott break method was used for continuous variables. This method aims to balance bin granularity with statistical robustness by minimizing estimation variance while preserving sufficient detail in the covariates. For categorical variables, natural levels were used without coarsening.

It is worth noting that the matching process prioritises untransformed data rather than log-transformed values, emphasising structural characteristics crucial for identifying similar municipalities, while still maintaining model accuracy (with a L1 distance = 0.247). In our analysis, we chose to match the treated and untreated Marche municipalities along four pre-treatment covariates: altimetric zone (plains, hills, mountains), population density and population size (for which data were gathered from the 2011 Italian census database) and mean per capita municipal declared income (as reported by the Italian Ministry of Economics and Finance from individual fiscal declarations between 2012 and 2019). We believe that these variables are measure dimensions relevant to explain both the level and composition of procurement activity such as urbanization, spatial and administrative scale, socio-economic capacity.

4.6.2 Density discontinuity testing

With the aim of testing bouncing below the threshold, we rely on the methodological framework proposed by Cattaneo et al. (2020), which extends the McCrary test (McCrary, 2008) into a robust non-parametric setting for density discontinuity testing. This approach is particularly suited for identifying manipulation or strategic sorting in the running variable – in this case, the estimated contract value.

The objective of the test is to evaluate whether the distribution of contract values exhibits a discontinuous jump at the relevant threshold, which would suggest that procurement officers

are deliberately setting contract values just below the threshold to retain procedural discretion. The central assumption is that in the absence of manipulation, the density of the running variable (contract value ccc) should be smooth and continuous at the threshold TTT.

Formally, the analysis tests:

$$H_0: \lim_{x \uparrow \bar{x}} f(x) \;=\; \lim_{x \downarrow \bar{x}} f(x) \;\; vs \quad H_1: \lim_{x \uparrow \bar{x}} f(x) \;\neq\; l \lim_{x \downarrow \bar{x}} f(x)$$

Rejection of the null hypothesis implies a discontinuity in the density function at the threshold TTT, which is interpreted as evidence of manipulation.

The estimator uses local polynomial regression on either side of the threshold to estimate the density function and the size of the discontinuity. Bandwidth selection is data-driven and employs bias-corrected optimal procedures. The robustness of the estimator lies in its ability to accommodate irregular designs, including high kurtosis and local heteroskedasticity in the data.

4.6.3 Triple Difference-in-Differences Analysis

The density and discontinuity analyses presented above indicate that municipalities manipulate contract values through bunching. However, it remains unclear whether such manipulation ultimately translates into greater reliance on simplified procedures, namely direct awards. To check whether this actually happens, we employ a triple difference design that compares the presence of direct awards before and after the earthquake across treated and control municipalities. This analysis considers heterogeneity in procurement categories**.**

To implement the triple difference estimator, we first transform the procurement data into a balanced panel where each observation corresponds to a municipality observed at a monthly frequency between 2014 and 2018. This structure allows us to precisely identify the dynamic effects of the earthquake by exploiting variation in treatment timing across municipalities. The panel is constructed using Stata's *collapse* command, which aggregates tender-level data to the municipality-month level, followed by *fillin* to ensure no gaps in the time series. The treatment group consists of municipalities in the emergency declaration of the Italian Civil Protection, while control municipalities are those that were not included that share similar features, as explained in the matching procedure.

The collapsed dataset retains key procurement outcomes, including the total number of tenders, the count and total value of tenders awarded with a direct award process, and the aggregate

value of all procurement. We further disaggregate tenders by type (goods, services) and procedure, distinguishing under-threshold contracts, direct awards, open procedures, and contracts linked to emergency measures. A bunching variable that captures procurement clustering, which may reflect post-disaster administrative responses, takes value 1 if the tender value is between 180.000€ and 200.000€ . These aggregates are retained at the municipality-month level, conditional on ISTAT municipality codes, publication year and month.

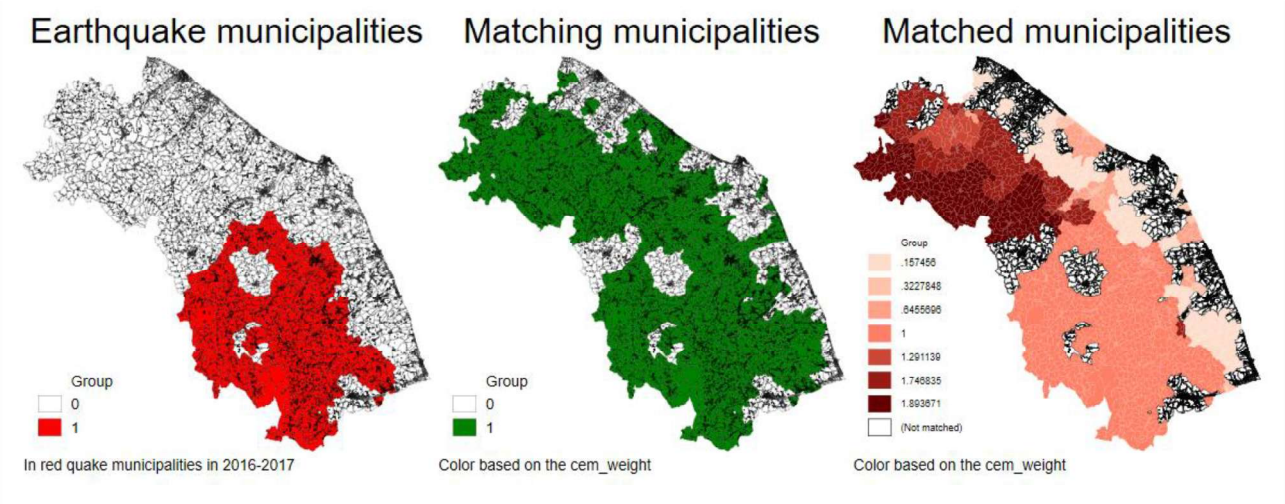
The triple difference design compares outcomes before and after the earthquake across treated and control municipalities, while also leveraging heterogeneity in procurement categories that may respond differently to emergency procurement rules. This approach accounts for time-invariant municipality characteristics, common time shocks, and pre-existing trends, under the assumption that, absent the earthquake, procurement patterns would have evolved similarly across treated and control municipalities. Concerns about omitted variable bias and serial correlation are addressed by the inclusion of municipal and monthly fixed effects, and by the precise alignment of treatment timing with monthly procurement data.

4.7 Results

4.7.1 Matching

Municipalities with a positive CEM weight below 2 were retained in the matched sample. Units in strata with disproportionate numbers of treated or control observations received weights reflecting their relative contribution to balance. Approximately 40% of units had a weight of 1 (i.e., came from perfectly balanced strata), while the rest were up- or down-weighted accordingly. Figure 6 shows the localization of the Marche municipalities shocked by the earthquake (map on the left) and the treated and untreated matched municipalities in the same region (map on the right).

Figure 6: Geographic localization of treated and matched municipalities in the Marche region



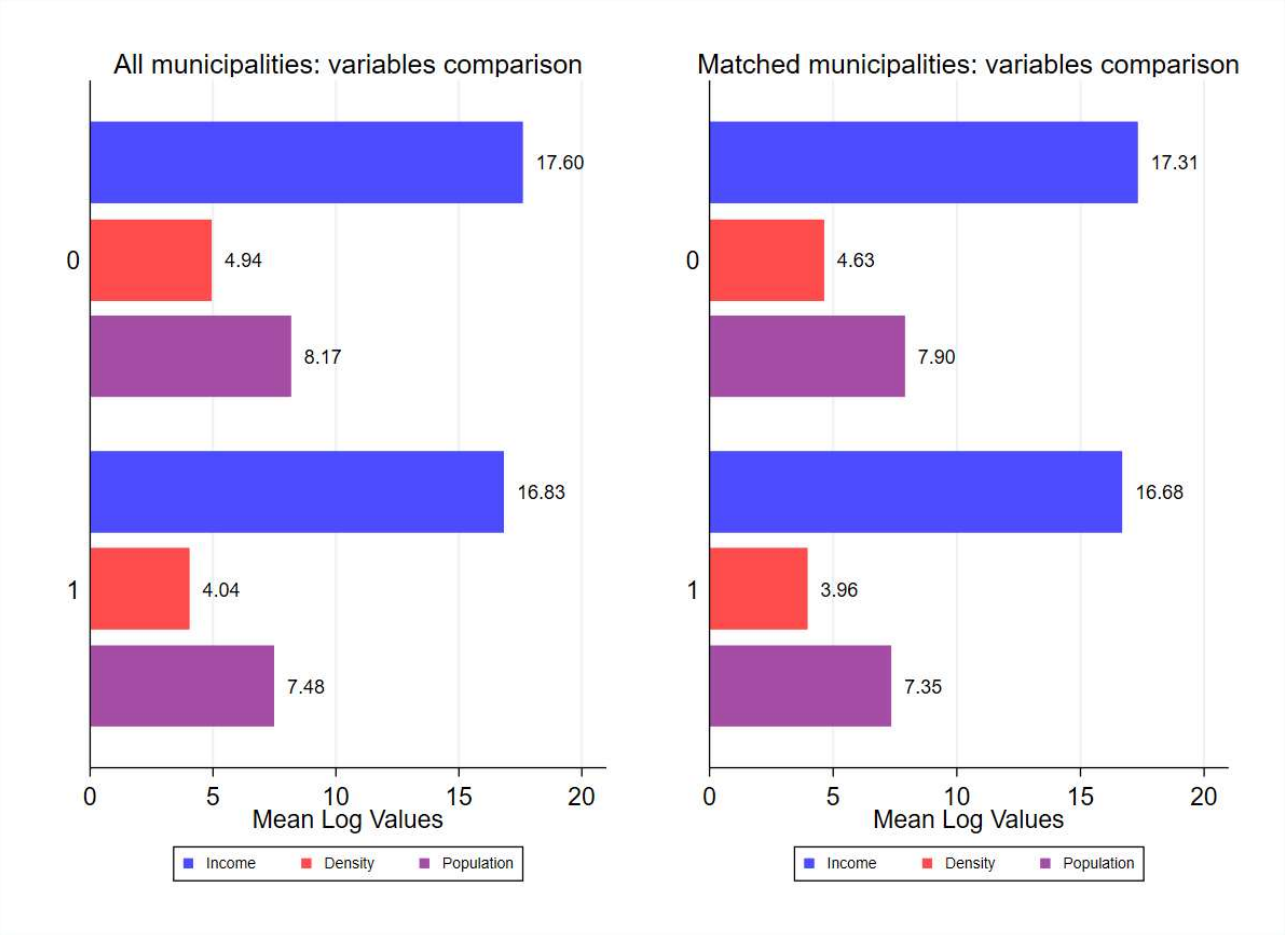
The summary statistics reported in Table 4 show that, prior to matching, treated and untreated municipalities differ substantially across all covariates – particularly in income and population size. After applying CEM, these differences are significantly reduced, especially for income and altimetric zone, supporting the internal validity of the design.

Table 4: Descriptive Statistics of Key Covariates Before and After Coarsened Exact Matching (CEM)

	All municipalities		Matched municipalities	
	Untreated	Treated	Untreated	Treated
Income (€)	1.06e+08	6.01e+07	5.81e+07	3.96e+07
Pop. Density	238.50	104.16	142.47	90.42
Altimetric zone				
n. Plains	153	198	15	22
n. Hills	399	411	38	49
n. Mountains	743	67	49	8
Population	7,544.21	4,571.44	4,351.53	3,113.58

Figure 7 reports bar plots that allow comparing treated and untreated mean (log-transformed) values further illustrate the improved covariate balance achieved through matching

Figure 7: Covariate balance before and after matching: log-transformed means for treated and untreated municipalities



After matching, we retain only the tenders issued in municipalities in the matched sample, which includes 6,976 contracts across 181 municipalities (79 treated, 102 untreated). This ensures that post-matching comparisons are made between units similar in observable characteristics, strengthening causal inference. Importantly, the composition of procurement objects in the matched sample differs from the full dataset, reflecting the distinctive structural profile of matched municipalities. Figure 8 shows that between 2014 and 2018, works contracts represent the largest share (47.43%), followed by services (36.21%) and goods (16.36%). Interestingly, during the immediate post-earthquake period (2016–2018), we observe a decline in the share of both goods and services (from 19.55% to 9.81%, and from 38.34% to 30.77%, respectively), accompanied by an increase in works procurement (from 42.12% to 59.41%). This shift likely reflects a transition from emergency response – characterized by the procurement of goods and immediate services – to infrastructure rebuilding efforts, which

demand more extensive works contracts. These dynamics underscore the importance of considering local structural needs when assessing procurement patterns in post-disaster settings.

Figure 8: Composition of public procurement tenders in matched municipalities by object and year (2014–18)

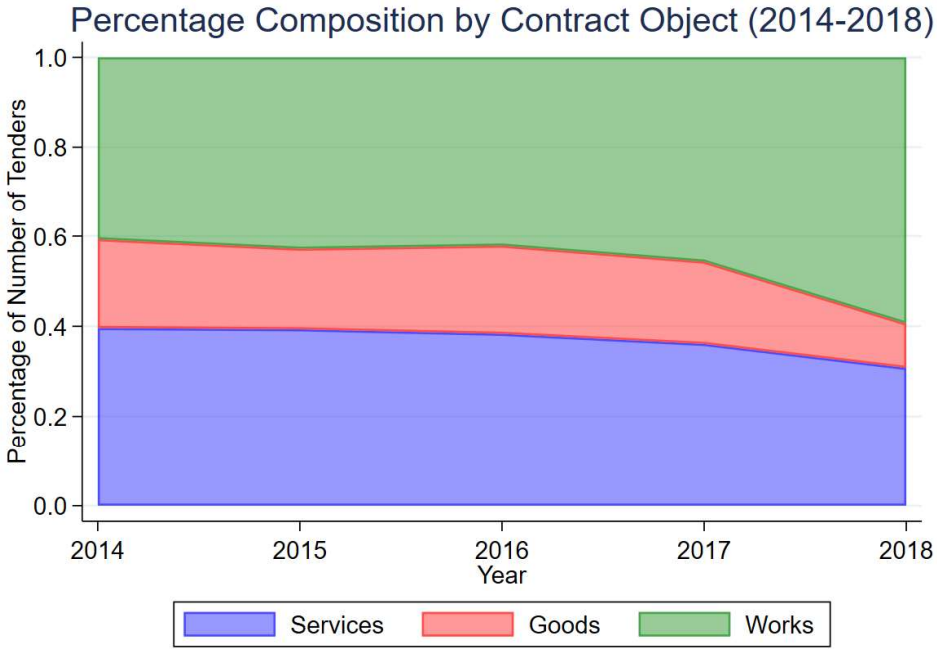


Figure 9 compares the annual trends in both the occurrence (left panels) and total value (right panels) of public procurement tenders across treated and untreated municipalities in the Marche Region between 2014 and 2018, disaggregated by contract object: (a) Goods, (b) Services. The vertical dashed line marks 2016, i.e. the year of the Central Italy earthquake, which constitutes the treatment condition.

Before 2016, treated municipalities consistently show lower procurement volumes – both in terms of number and value – across all categories. This divergence is expected and largely attributable to the smaller size and number of treated municipalities relative to the untreated group. Thus, pre-treatment differences do not reflect differential trends but rather structural differences in administrative scale and procurement capacity. In terms of trends, however, the two groups exhibit broadly similar trajectories, particularly from 2015 onward.

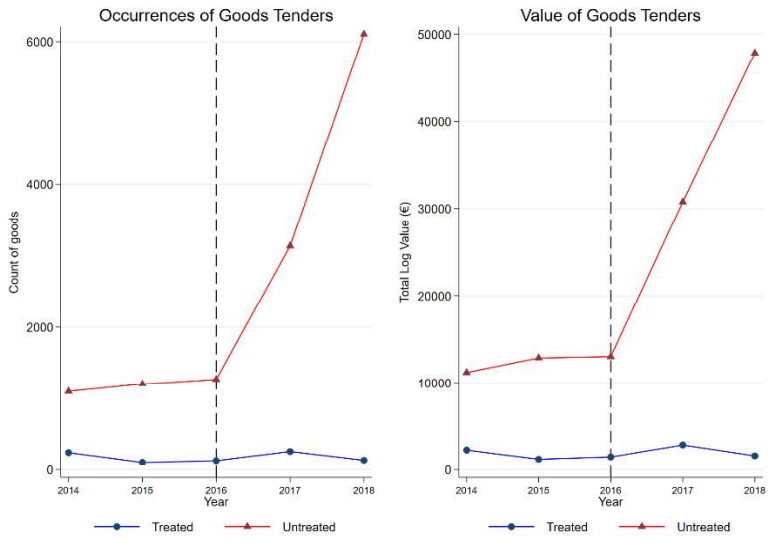
Compared to previous years, 2016 shows a reduction in procurement activity for goods and services in both treated and untreated municipalities. The earthquake constituted a severe and disruptive shock for the entire region, and even municipalities not directly affected appear to

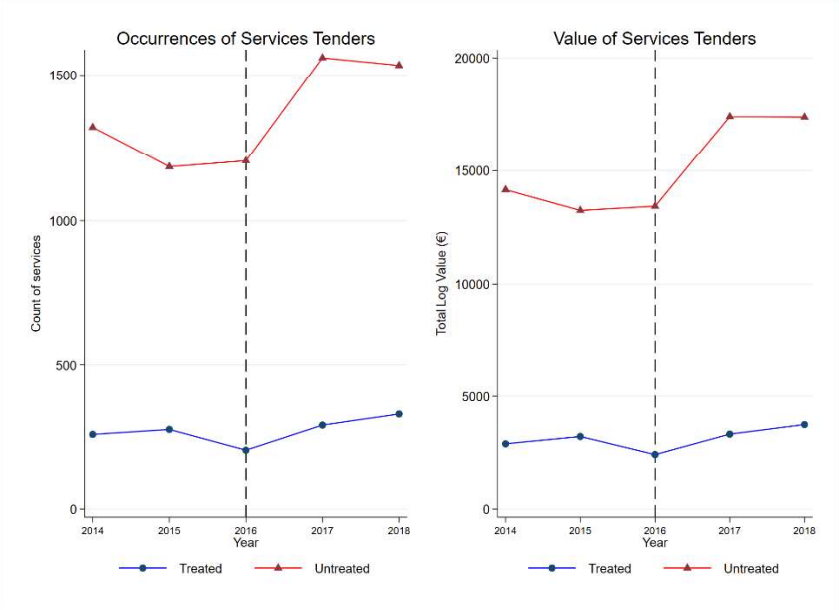
have temporarily decelerated procurement operations, possibly due to uncertainty and precautionary behaviour in the aftermath of the disaster. This pattern, however, only partially holds for works procurement. While non-affected municipalities show a decline in the number and value of works tenders in 2016, treated municipalities exhibit a sharp increase relative to previous years. This likely reflects the immediate need for post-disaster interventions, such as emergency repairs and reconstruction efforts.

After 2016, the treated and untreated trends sharply diverge. Treated municipalities exhibit a marked post-shock increase in procurement activity. The count and total value of works contracts grow remarkably between 2016 and 2018 surpassing those reported by non-affected municipalities. A similar, though more moderate, upward shift is observed for services, in both the untreated and especially the treated municipalities. While these latter municipalities' values remain below those reported by their counterparts, a reduction of distance between the two groups is observed. Finally, looking at goods, procurement in this category reports an evident increase in treated municipalities in the year after the shock while it decreases in the subsequent year.

Overall, this descriptive evidence is consistent with the hypothesis that the earthquake induced a shock to procurement demand, particularly in categories linked to reconstruction and public service continuity.

Figure 9: Annual occurrence and total value of public procurement tenders by contract object and earthquake (treatment) exposure (2014–2018)





4.7.2 Strategic Bunching in the Pre-Earthquake Period

Table 5 presents the results of a manipulation test for evidence of strategic bunching below the €207,000 procurement ordinary threshold active in the pre-earthquake period (2014–2015). The analysis of the pre-disaster period, encompassing the years 2014 and 2015, serves as a critical baseline for identifying regular procurement behaviour under ordinary institutional constraints. In this phase, all municipalities – treated and untreated alike – were operating under the same national procurement regime, governed by the ordinary threshold (Euros 207.000) that determined the procedural obligations for public tenders. The test is conducted separately for goods and services.

Table 5: Manipulation test 2014-2015

	Threshold €207.000	
Category	**T**	**P>|T|**
Services		
Treated	-3.0284***	0.0025
Untreated	-2.6742***	0.0075
Goods		
Treated	-1.2698	0.2042
Untreated	-1. 6913*	0.0908

*** p<0.01, ** p<0.05, * p<0.1

The T-statistics and associated p-values provide strong evidence of discontinuities in the distribution of services contract values just below the 207.000 euros threshold. For services,

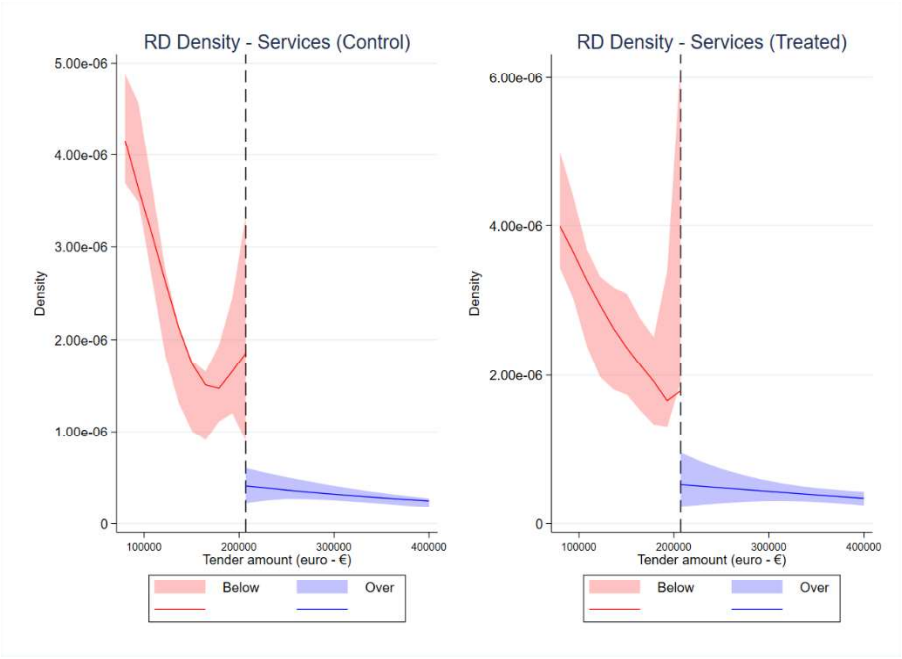
both treated (i.e. those municipalities that would have been shocked by the earthquake in subsequent year) and untreated municipalities exhibit statistically significant negative discontinuities (T = –3.02, p = 0.0025 for treated; T = –2.67, p = 0.0075 for untreated). On the whole, this finding is consistent with strategic bunching behaviour by contracting authorities. This indicates an unusually high concentration of contracts just below the €207,000 threshold, suggestive of regulatory avoidance aimed at circumventing more burdensome procedures required above the cutoff.

The symmetry in manipulation behaviour across treated and untreated municipalities during the pre-disaster period for services further reinforces the validity of the subsequent comparative analysis. It suggests that, prior to the earthquake, there were no systematic behavioural differences between the two groups in terms of threshold manipulation for services. This provides a strong foundation for interpreting any observed divergence in the disaster period as being attributable to the institutional changes triggered by the emergency.

Looking at goods, the bunching pattern is even more pronounced among treated municipalities for which we find a strongly statistically significant negative discontinuity (T = –4.99, p = 0.0246). Instead, untreated municipalities display a negative but just about not significant discontinuity (T = -1.62, p = 0.1037).

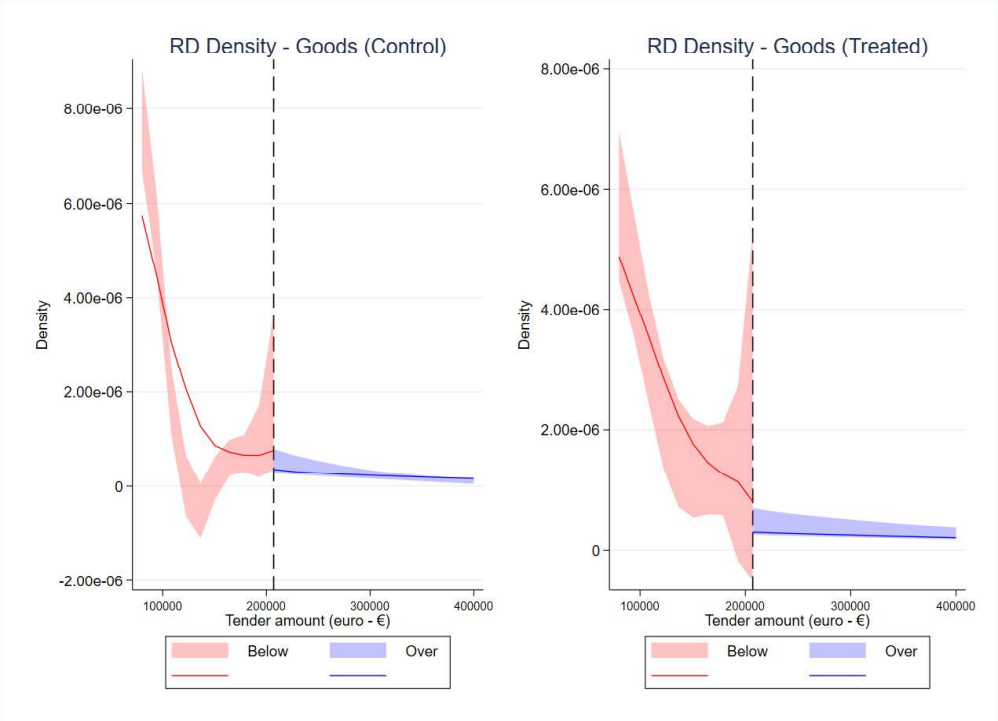
In line with these findings, the nonparametric density estimation illustrated in Figure 10 reveals a statistically significant discontinuity in the distribution of service contract values just below the 207.000 threshold. Both treated and untreated municipalities display clear bunching, i.e., a higher-than-expected density of tender amounts immediately below the regulatory cutoff. This suggests that procurement officers in both groups strategically adjust contract values to remain within the scope of simplified procedures. These findings are consistent with existing literature indicating that services procurement, due to its intangible nature and often subjective evaluation criteria, affords greater administrative discretion and flexibility compared to goods procurement (Fazekas and Kocsis, 2020; Coviello et al., 2022).

Figure 10: RDD density at the ordinary €207,000 threshold for services in the pre-treatment period



By contrast, the analysis of goods tenders presented in Figure 11 does not show a similar bunching behaviour. The density of contract values appears relatively below the threshold for both treated and untreated municipalities although with little or no statistical significance.

Figure 11: RDD density at the ordinary €207,000 threshold for goods in the pre-treatment period



4.7.3 Strategic Bunching in the Post-Earthquake Period

The post-disaster period, covering 2016 and 2017, coincides with the seismic events that affected central Italy and the ensuing activation of emergency procurement provisions. In the municipalities classified as treated, the institutional environment changed markedly: they became eligible to use elevated emergency thresholds designed to expedite procurement procedures for disaster recovery and infrastructure rehabilitation. The ordinary threshold, instead, remained mostly stable, slightly increasing from €207,000 to €209,000.

The results in Table 6 reveal a pronounced and statistically significant increase in the density of service tenders just below the €200.000 emergency threshold is detected. This bunching pattern is strongly localized, with a clear spike in the distribution of contract values just under the emergency limit. The shift in manipulation behaviour – from Threshold €207.000 in the pre-disaster period to Threshold €200.000 in the post-disaster period – suggests a strategic adjustment by procurement officials in response to the expanded procedural leeway afforded by emergency regulations.

Table 6: Manipulation test 2016-2017

	Threshold €200.000€ (urgency)		**Threshold €209.000**	
Category	**T**	**P>|T|**	**T**	**P>|T|**
Services				
Treated	-3.1914***	0.0014	-2.7035***	0.0069
Untreated	-1.0757	0.2821	-2.7856***	0.0053
Goods				
Treated	-1.1432	0.2530	-0.9356	0.3495
Untreated	0.1665	0.8677	-1.5847	0.1130

*** p<0.01, ** p<0.05, * p<0.1

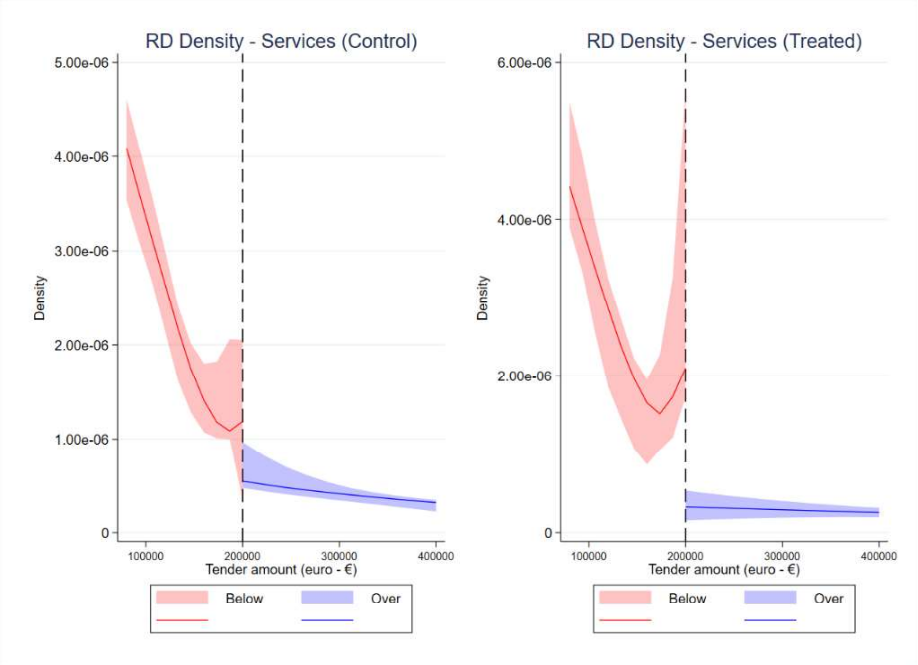
In contrast, untreated municipalities – those not affected by the earthquake and therefore still subject to the standard threshold – do not exhibit bunching behaviour around the emergency threshold. This reinforces the inference that the shift observed in treated municipalities is not a general temporal trend but rather a disaster-induced institutional effect.

Notably, no significant manipulation is observed in the goods procurement category, even among treated municipalities operating under emergency conditions.

Figure 12 reveals that service tenders display a marked discontinuity at the emergency threshold. The density of tenders drops sharply just above €200,000 and is significantly higher

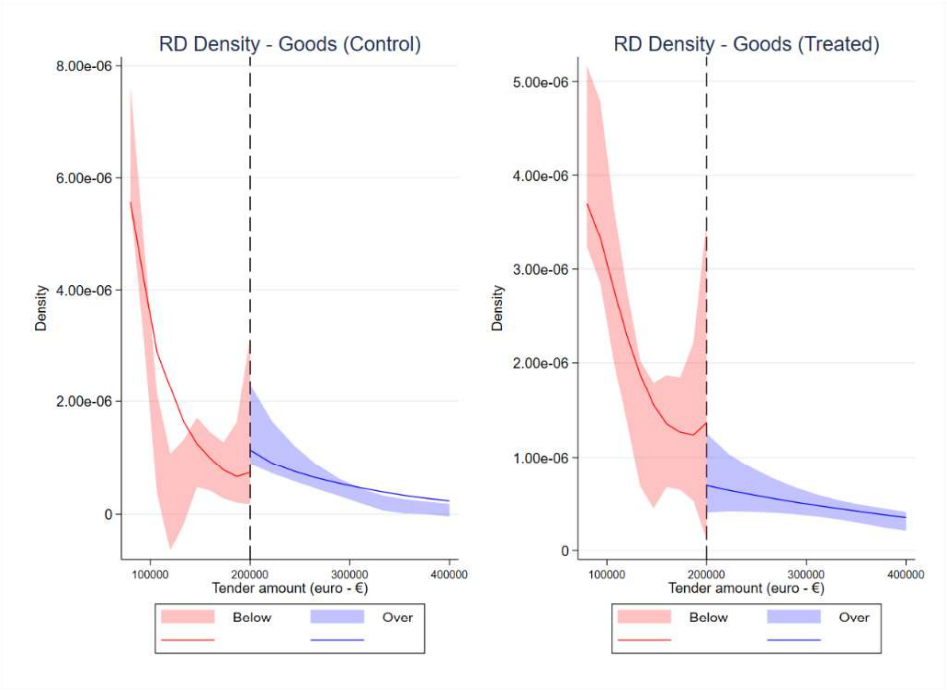
just below the threshold. This suggests the presence of strategic bunching, i.e., an unusually high concentration of tender amounts just below the threshold – presumably to benefit from simplified procurement procedures that apply below this regulatory limit. The visual evidence supports the formal manipulation test reported in Table 4, where the treated municipalities exhibit a statistically significant negative discontinuity (T = –3.19, p = 0.0014). Together, these findings indicate that after the earthquake, and the introduction of emergency procurement rules, some municipalities exploit the new thresholds, as they had done with non-emergency thresholds, engaging in opportunistic behaviour aimed at avoiding stricter regulatory.

Figure 12: RDD density at the ordinary €200,000 threshold (urgency threshold) for services in the post-treatment period



Results for goods and services are consistent with previous findings, where opportunistic behaviour does not seem to be present, as shown by both Table 6 and Figure 13.

Figure 13: RDD density at the ordinary €200,000 threshold (urgency threshold) for goods and services in the post-treatment period



4.7.4 Volume of Direct Awards

Table 7 reports the results of the triple difference analysis.

Table 7: Triple difference design

Variables	(1) Share DAP value	(2) Share DAP value
Post_event	1.363 (0.956)	0.116 (0.520)
T_16 x post_event	0.484 (0.735)	0.496 (0.732)
T_16 x bunching	-8.693** (0.036)	-8.408** (3.886)
Post_event x bunching	2.496 (4.108)	2.448 (4.104)
T_16 x post_event x bunching	13.273** (5.504)	12.870** (5.498)
Constant	311.53** (150.13)	305.74** (129.37)
Observations	10,740	10,740
R-squared	0.205	0.207
Controls	Yes	Yes
Fixed effects	Year Municipality	Month Municipality

*** p<0.01, ** p<0.05, * p<0.1

All the specifications present estimates where the dependent variable is the share of direct award value relative to total procurement value in a municipality-month. Column (1) presents results with municipality and year fixed effects, accounting for yearly unobserved characteristics. While Column (2) presents has municipality and month fixed effects, in this way we present results that capture cyclical procurement behaviour in the year. Moreover, they include a rich set of controls, such as the log of contract value, the procurement category dummies, the municipality characteristics such as log population and log of income.

The coefficient of interest is the triple interaction term, T_16 × post event × bunching, which captures the differential change in direct award behaviour in treated municipalities (included in emergency declaration – T_16) following the 2016 earthquake (post_event), that exhibit bunching behaviour (at least on tender between €180.000 and €200.000), relative to non-treated municipalities and controlling for pre-existing trends.

Across both specifications, this coefficient is positive and statistically significant at the 5% level, with point estimates of 13.3 and 12.9 percentage points, respectively. This suggests that in response to the relaxation of direct award thresholds introduced in the emergency decree, treated municipalities with a prior tendency to bunch contract values just below the legal threshold disproportionately increased their reliance on direct awards in value terms.

This pattern indicates a heterogeneous behavioural response to the reform: municipalities with a documented history of concentrating procurement values near the threshold responded more aggressively to the expanded discretion, shifting a larger share of their procurement budget toward direct awards.

Notably, the main effects of the reform (e.g., *T_16 × post_event*) are small and statistically insignificant, reinforcing the interpretation that the reform's impact was not uniform, but rather concentrated in a subset of municipalities already exhibiting strategic behaviour prior to the regulatory change.

The negative and significant coefficient on *T_16 × bunching* (approx. –8.4 percentage points) further suggests that prior to the reform, treated municipalities that bunched actually allocated less procurement value through direct awards than non-bunching treated peers. This makes the post-reform increase even more striking, implying a sharp behavioural shift among this subgroup once regulatory constraints were relaxed.

4.8 Robustness checks

A key assumption underlying our analysis is that the observed bunching below the procurement thresholds reflects intentional behaviour by contracting authorities, rather than spurious data patterns. This is a central identification challenge in Regression Discontinuity literature in order to distinguish strategic manipulation from naturally occurring discontinuities in the data. To validate this assumption and rule out alternative explanations, we implement a series of robustness checks using different thresholds (i.e *placebo thresholds*), following the standard practice in the literature that uses regression discontinuity to detect bunching (e.g., Palguta and Pertold, 2017).

The logic of this test is to verify whether significant bunching appears at monetary values that carry no institutional significance. The presence of bunching at such placebo thresholds would indicate that our results might be driven by arbitrary features of the data, such as a natural tendency for contract values to cluster at round numbers. Conversely, the absence of bunching at these placebo thresholds, coupled with its presence at the true threshold, provide strong evidence that the observed manipulation is linked to the specific regulatory incentive.

For this test, we examine two placebo thresholds at €150,000 and €175,000. We selected these values for a series of reasons. First, their proximity to the institutional emergency and non-emergency thresholds ensures that they reside in a similar region of the contract value distribution, controlling for potential local data artifacts. Second, and crucially, we have verified that these values do not correspond to any other official procurement thresholds or regulatory milestones in the relevant legislation. Lastly, these specific amounts allow us to test for – and rule out – non-strategic bunching at salient round numbers. Therefore, they serve as ideal counterfactuals where no strategic bunching should occur. Table 8 presents Density Discontinuity Test at the €150,000 placebo threshold. As for the main results, separate bandwidths for each side of the threshold are used to account for asymmetric distribution, as using common bandwidth may lead to biased estimates or inefficient inference because it assumes distributional characteristics on both sides.

Table 8: Manipulation test at 150.000€ placebo threshold on 2016-2017

	Threshold €150.000	
Category	**T**	**P>|T|**
Services		
Treated	0.6207	0.5348
Untreated	3.2466***	0.0012
Goods		
Treated	-0.3146	0.7531
Untreated	0.4124	0.6800

*** p<0.01, ** p<0.05, * p<0.1

As the table demonstrates, we find no statistically significant evidence of bunching below the €150,000 placebo threshold for the treated entities in either the Services (T = 0.6207, p = 0.5348) or Goods (T = -0.3146, p = 0.7531) sectors. This null result is precisely what the identification strategy requires. It indicates that our empirical procedure does not mechanically detect "bunching" in regions of the density where no incentive for manipulation exists. Consequently, we can rule out the explanation that our main findings are driven by arbitrary data features, such as a general tendency for contract values to cluster at round numbers. The analysis also reveals some statistically significant coefficients for the untreated group. However, these patterns are inconsistent with strategic threshold avoidance. For instance, the significant result for untreated municipalities in Services indicates bunching *above* the threshold (T = 3.2466, p = 0.0012), which is the opposite of the behaviour predicted by the manipulation hypothesis. Similarly, the point estimate for untreated municipalities in Goods is positive but insignificant. The lack of a coherent, systematic pattern of bunching *below* the placebo threshold across any group reinforces the conclusion that there is no strategic force acting at this value. The significant but contradictory results for the untreated group are likely spurious or reflect idiosyncratic, non-strategic clustering in the data that is uncorrelated with the treatment.

Moreover, the same procedure has been followed for a second placebo threshold at 175.000 euros, of which the results are presented in Table 9.

Table 9: Manipulation test at 175.000€ placebo threshold on 2016-2017

	Threshold €175.000	
Category	**T**	**P>|T|**
Services		
Treated	0.0841	0.9330
Untreated	-1.8677*	0.0618
Goods		
Treated	0.9264	0.3542
Untreated	1.5778	0.1146

*** p<0.01, ** p<0.05, * p<0.1

This scenario further reinforces the null findings from the first placebo test. For the treated municipalities – the group for which a strategic response to the actual threshold is identified – we again find no statistically significant evidence of bunching. The point estimates for both Services (T = 0.0841, p = 0.9330) and Goods (T = 0.9264, p = 0.3542) are negligible and not statistically significant. This repeated absence of a significant effect at a second, distinct placebo value powerfully indicates that the estimation method is not spuriously generating signs of manipulation.

The results for the untreated group at this threshold also bolster the case against a systematic data artifact. While a marginally significant effect appears for Services (T = -1.8677, p = 0.0618), its weakness (significant only at the 10% level) and its isolation – with no corresponding effect for Goods or for the treated group – suggest it is likely a spurious occurrence. The complete lack of any significant bunching for untreated municipalities in the Goods sector at this threshold further underscores the inconsistency of these patterns. The absence of a coherent and replicable signal across both treated and untreated groups at this institutionally irrelevant value is precisely what the identification strategy requires to rule out confounding data heaps.

In summary, the tests yield a clear null result for the entities of interest and support the credibility of the main findings. The absence of consistent and significant bunching at the placebo thresholds (150,000€ and 175,000€) strengthens the case that the systematic and consistent bunching observed around €200,000, €207,000 and €209,000 is not due to chance, but is instead driven by behavioural responses to the actual institutional thresholds. This clear dichotomy reinforces the conclusion that actors adjusted their procurement behaviour in response to incentives or regulatory constraints tied to these specific cutoff values, therefore the excess mass we document is a specific behavioural response to the regulatory discontinuities and not an artifact of the underlying distribution of project values.

4.9 Discussion and conclusion

The differential behaviour observed across time, treatment groups, and procurement types suggests a form of strategic adaptation by municipal authorities in response to institutional shocks.

The activation of new thresholds in treated municipalities coincided with a notable relocation of bunching behaviour to the new regulatory cutoff. This substitution effect – shifting from manipulation just below Threshold A in the pre-disaster period to manipulation just below Threshold B in the disaster period – is consistent with the hypothesis that procurement agents adjust their behaviour opportunistically to maximize discretion under prevailing legal constraints. This pattern does not emerge among untreated municipalities, which continued to operate under the standard regime and displayed stable manipulation behaviour across the two time periods. This evidence thus points to a causal relationship between the activation of emergency thresholds and the intensification of threshold-related manipulation.

While the results are suggestive of opportunistic behaviour, it is important to note that the density discontinuity test cannot directly infer intent or identify the beneficiaries of manipulation. Nonetheless, the sharp clustering of contract values just below the legally permissible threshold – especially following an exogenous shock that modified the rules – constitutes a strong empirical signal of *non-random procurement behaviour*.

The triple difference (DDD) analysis further shows that municipalities with a prior tendency to bunch contract values just below the legal limit markedly increased their use of direct awards in monetary terms after the emergency. This reveals a heterogeneous reaction to the reform: those with a history of strategic bunching shifted a larger share of their procurement budgets toward direct awards, while the overall urgency effects were small and insignificant, indicating the change mainly affected this specific subgroup. Interestingly, before the earthquake, bunching municipalities allocated less procurement value to direct awards than their non-bunching counterparts, making their post-event surge even more sizable and suggestive of a sharp behavioural shift once discretion was expanded.

These findings resonate with broader theories of institutional opportunism: when faced with a relaxation of oversight and an increase in discretion, public officials may recalibrate their strategies to extract administrative advantages, circumvent competitive constraints, or favor specific suppliers (Palguta and Pertold, 2017; Szucs, 2024). The persistence of this behaviour

in the service sector further underscores the need for differentiated monitoring tools, as certain procurement categories appear systematically more exposed to governance risks.

In our opinion motivation lies in characteristics of service contracts where the object and estimated value are often less standardized than for goods or public works and can more easily circumvent rigid procedures (Spiller, 2008). Furthermore, for goods, the market price is more observable and comparable, and the object is more tangible. As stated in the official site of the Canadian Office of the Procurement Ombudsman[7] "The crucial difference in goods versus service procurement comes down to a distinction in purpose. A good is acquired because an article that takes the form of equipment, materials or supplies is needed. By contrast, the procurement of services tends to solve a problem instead of solely acquiring a physical item. The way that service should be bought is different than buying a good. Rather than going to market to buy a specific item (as in goods procurement), one goes to tender seeking solutions to solve a problem". Such distinguishing features could have made the use of direct procedures more palatable in the case of emergency when fast and easy solutions are key to address troubling situations.

This study also speaks to the broader debate on the tension between restrictive rules and the flexibility required in times of emergency, a recurrent theme both in administrative law and in the economics of procurement. As highlighted by Bandiera, Bosio and Spagnolo (2022), discretion may be valuable under critical circumstances but risks undermining transparency and accountability. Indeed, adding to the limited literature on the topic (Fazekas et al., 2025; Marcolongo, 2023), this study suggests that corruption risks can be a matter of particular concern after natural hazards (Alexandre, 2017). Our findings suggest that, in addition to influencing municipalities' spending behaviour, and increasing local government expenditure (Masiero and Santarossa, 2019) as well as investments (Lodi et al., 2023) immediately after the shock, the occurrence of extreme events poses a significant threat to the integrity of institutions. This threat must be addressed through an appropriate system of checks and balances that does not hinder the timely allocation of resources. Designing such a system is a challenge that public administrations are therefore obliged to meet, by identifying the areas with higher exposure to corruption that warrant the attention of civil society and citizens at large, and in which to focus investment on prevention activities and oversight mechanisms. In this regard, the integrity pacts – promoted also at the EU level as collaborative monitoring tools between contracting

authorities and civil society – represent a concrete proposal to mitigate corruption risks in emergency procurement while preserving the timeliness of resource allocation (Abramo, 2003).

Of course, this study is not without limitations. First, the focus on one single Italian region constrains the external validity of our findings, which may not generalize to other Italian regions or international contexts. Second, the temporal window (2014–2018) allows us to capture short-term adaptations but does not provide evidence on the persistence of strategic behaviour in the medium or long run. Third, while the combination of matching, density discontinuity tests, and triple-difference analysis enhances credibility, these methods cannot fully disentangle strategic manipulation from legitimate procurement needs in the aftermath of a disaster. Nevertheless, the sharp concentration of tenders just below the new legal cutoffs, together with the consistency of results across different specifications and placebo tests, gives us confidence that strategic behaviour plays a central role in explaining the findings. Finally, our analysis provides evidence of bunching patterns and direct awards which could be considered as proxies for governance risks; nevertheless, they do not directly assess corruption and efficiency losses, which would be crucial to substantiate the broader governance implications of our findings.

Notes

[1] https://www.u4.no/blog/measuring-what-matters-in-a-crisis-reforming-corruption-risk-assessment-in-emergencies

[2] The Legislative Decree No. 56 of 19 April 2017 (the so-called "correttivo"), introduced important technical and clarifying amendments to the Legislative Decree No. 50/2016 but did not alter the monetary thresholds defined in Article 35 (see below). These thresholds, aligned with EU rules, are revised biennially by the European Commission. For sub-central authorities—such as the municipalities examined in this study—the threshold for contracts concerning goods and services remained at €209,000 from 2016 through the end of 2018. Notably, a further adjustment to the relevant thresholds only occurred in 2018 with the entry into force of EU Regulations 2017/2365, 2017/2364, and 2017/2366.

[3] It is worth noting that the emergency threshold applied also to works but these latter are not considered in the analysis as they were subject to different threshold in normal times, as explained above.

[4] Between 2014 and 2018, the procedures for public works evolved significantly. Under Legislative decree 163/2006 (in force until April 2016), works up to €500,000 could be awarded using simplified negotiated procedures with at least 5 invited firms, while contracts between €500,000 and €1 million required a negotiated procedure without prior publication, inviting at least 10 operators. With the entry into force of Legislative decree 50/2016, works between €40,000 and €150,000 required a negotiated procedure similar to the one accorded to goods and services in art. 35, with the evaluation of comparison of at least three bids. Other thresholds apply between 150.000 and 350.000 and between 350.000 and 1 million euro. This brief description evidence that the picture for work was extremely heterogeneous, differently from what found in Fazekas et al. (2025), which refers to a generic full open tendering process €1,000,000 threshold.

[5] Between 2000 and 2024, resources allocated by the State to territorial entities in the Marche Region for the fight against hydrogeological instability—including those granted to the President of the Region in his capacity as Government Commissioner for hydrogeological risk—amounted to €521 million. This corresponds to approximately €526,000 per km² of medium-high risk territory, a figure nearly 80 percent higher than the national average (Banca D'Italia, 2025, pp. 58-59)

[6] Municipalities in the Marche Region damaged by the Central Italy earthquake, following the events of 24 August, 26 October, and 30 October 2016, as listed in Annexes 1 and 2 of Decree-Law No. 189 of 17 October 2016, converted into law by Law No. 229 of 15 December 2016.

[7] https://opo-boa.gc.ca/autresrapports-otherreports/rmbprms-rgvsc-eng.html

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Appendix C

Tables C1 and C2 present the detailed sectoral composition of services, classified according to the Common Procurement Vocabulary (CPV), which identifies the specific area of intervention, for procurement contracts issued in both affected and control municipalities.

Beyond aggregate funding patterns, substantial shifts emerge in the composition of service spending after the 2016 earthquake for the treated municipalities. *Financial and insurance services* experience the largest expansion, rising by nearly seven percentage points relative to pre-disaster levels and reaching about 40 percent of total service funding by 2017–2018. *Architectural, construction, engineering and inspection services*, along with *Repair and maintenance*, also increase markedly, reflecting intensified reconstruction needs. Conversely, *Business services* contract sharply, suggesting a reallocation of resources toward infrastructure recovery and risk management. Overall, these dynamics point to a clear reorientation of service procurement toward reconstruction, technical, and financial functions in the aftermath of the earthquake.

On the other hand, in control municipalities, service composition exhibits more moderate post-2016 shifts relative to treated municipalities. *IT and computer services* experience the largest increase, rising from roughly 1 percent in 2014–2015 to nearly 6 percent in 2016–2018. *Financial and insurance services*, *Repair and maintenance*, and *Architectural, construction, engineering and inspection services* also increase modestly. In contrast, *Health and social work services*, *Sewage, refuse, cleaning and environmental services*, and *Other community, social and personal services* decline over the same period. Overall, control municipalities display smaller post-2016 fluctuations, suggesting that the marked funding reallocations observed in treated municipalities are specific responses to the earthquake rather than general temporal trends.

Table C1 – CPV Sector for treated municipalities

CPV sector	2014	2015	2016	2017	2018
Other community, social and personal services	4,7%	3,3%	5,4%	3,0%	2,5%
Medical equipments, pharmaceuticals and personal care products	0,0%	0,5%	0,0%	0,0%	0,0%
Laboratory, optical and precision equipments (excl. glasses)	0,0%	0,0%	0,8%	0,5%	0,4%
Transport equipment and auxiliary products to transportation	0,0%	0,0%	1,6%	1,5%	2,1%
Radio, television, communication, telecommunication and related equipment	0,0%	0,0%	0,0%	0,5%	0,8%
Construction work	0,7%	0,0%	0,8%	0,5%	0,4%
Office and computing machinery, equipment and supplies except furniture and software packages	0,0%	0,0%	0,8%	1,0%	0,4%
Software package and information systems	1,3%	0,5%	0,0%	1,5%	0,4%
Food, beverages, tobacco and related products	0,7%	0,5%	0,0%	0,0%	0,0%
Agricultural, farming, fishing, forestry and related products	0,0%	0,0%	0,0%	0,0%	0,4%
Petroleum products, fuel, electricity and other sources of energy	0,7%	0,0%	0,8%	0,0%	0,4%
Hotel, restaurant and retail trade services	6,0%	11,0%	6,2%	4,0%	7,6%
Architectural, construction, engineering and inspection services	6,7%	4,9%	7,8%	10,6%	7,1%
Agricultural, forestry, horticultural, aquacultural and apicultural services	1,3%	0,5%	2,3%	0,5%	1,3%

Installation services (except software)	0,0%	0,0%	0,0%	0,0%	0,4%
Education and training services	0,7%	0,5%	0,0%	0,0%	0,4%
Postal and telecommunications services	0,7%	1,6%	0,8%	0,5%	0,0%
Administration, defence and social security services	0,0%	0,0%	0,0%	0,5%	0,8%
Research and development services and related consultancy services	0,7%	0,0%	0,8%	0,0%	0,0%
Repair and maintenance services	7,4%	1,1%	8,5%	7,5%	5,0%
Transport equipment and auxiliary products to transportation	0,0%	0,5%	0,0%	0,0%	0,0%
Transport services (excl. Waste transport)	3,4%	7,7%	10,1%	1,5%	7,6%
Financial and insurance services	24,8%	30,8%	23,3%	40,2%	39,9%
Sewage, refuse, cleaning and environmental services	13,4%	12,6%	8,5%	11,6%	6,3%
Real estate services	0,0%	0,0%	0,8%	0,0%	0,0%
IT services: consulting, software development, Internet and support	2,0%	0,0%	0,8%	2,0%	4,2%
Business services: law, marketing, consulting, recruitment, printing and security	13,4%	7,7%	3,9%	3,0%	2,5%
Public utilities	0,0%	1,6%	0,8%	0,0%	0,8%
Recreational, cultural and sporting services	3,4%	2,2%	3,1%	1,0%	2,1%
Health and social work services	8,1%	12,1%	11,6%	8,5%	5,9%

Chemical products	0,0%	0,0%	0,8%	0,0%	0,0%

Table C2 – CPV Sector for control municipalities

CPV sector	2014	2015	2016	2017	2018
Collected and purified water	0,3%	0,0%	0,0%	0,0%	0,0%
Other community, social and personal services	4,5%	2,8%	3,2%	2,8%	1,8%
Medical equipments, pharmaceuticals and personal care products	0,3%	0,0%	0,0%	0,0%	0,0%
Security, fire-fighting, police and defence equipment	0,3%	0,3%	0,0%	0,0%	0,0%
Transport equipment and auxiliary products to transportation	0,6%	0,3%	0,7%	0,3%	0,9%
Radio, television, communication, telecommunication and related equipment	0,0%	0,0%	0,7%	0,0%	0,6%
Construction work	1,8%	0,6%	1,1%	0,8%	0,6%
Machinery for mining, quarrying, construction equipment	0,3%	0,0%	0,7%	0,6%	0,3%
Office and computing machinery, equipment and supplies except furniture and software packages	0,0%	0,6%	0,0%	0,0%	0,3%
Furniture (incl. office furniture), furnishings, domestic appliances (excl. lighting) and cleaning products	0,3%	0,3%	0,0%	0,0%	0,0%
Software package and information systems	0,6%	0,9%	0,0%	0,3%	0,3%

Food, beverages, tobacco and related products	0,0%	0,6%	0,0%	0,0%	0,0%
Agricultural, farming, fishing, forestry and related products	0,3%	0,0%	0,0%	0,0%	0,0%
Petroleum products, fuel, electricity and other sources of energy	1,2%	1,3%	0,4%	0,8%	0,9%
Hotel, restaurant and retail trade services	6,0%	3,5%	6,9%	7,2%	5,3%
Architectural, construction, engineering and inspection services	3,6%	2,2%	4,0%	2,8%	6,8%
Agricultural, forestry, horticultural, aquacultural and apicultural services	1,5%	1,3%	1,4%	3,0%	1,2%
Installation services (except software)	0,6%	0,0%	0,0%	0,3%	0,0%
Education and training services	2,1%	3,5%	3,6%	2,8%	1,8%
Postal and telecommunications services	0,9%	1,9%	0,7%	0,6%	1,2%
Administration, defence and social security services	1,5%	0,6%	0,7%	0,0%	0,3%
Research and development services and related consultancy services	0,0%	0,0%	0,4%	0,0%	0,0%
Repair and maintenance services	5,1%	2,8%	4,3%	4,4%	6,5%
Supporting and auxiliary transport services; travel agencies services	0,0%	0,0%	0,7%	0,0%	0,3%
Transport services (excl. Waste transport)	4,2%	4,4%	4,0%	5,0%	5,3%
Financial and insurance services	20,7%	20,9%	16,6%	27,5%	26,5%
Sewage, refuse, cleaning and environmental services	10,2%	17,1%	14,4%	8,3%	9,7%

Real estate services	0,0%	0,0%	0,0%	0,6%	0,3%
IT services: consulting, software development, Internet and support	0,9%	1,3%	1,4%	6,6%	9,7%
Servizi per le imprese: servizi giuridici, di marketing, di consulenza, di reclutamento, di stampa e di sicurezza	4,5%	5,4%	5,8%	3,3%	3,8%
Business services: law, marketing, consulting, recruitment, printing and security	1,5%	0,9%	0,7%	0,3%	0,9%
Recreational, cultural and sporting services	2,7%	4,7%	2,5%	2,2%	2,9%
Health and social work services	23,1%	21,5%	24,2%	19,8%	11,8%
Chemical products	0,3%	0,0%	0,0%	0,0%	0,0%
Printed matter and related products	0,3%	0,0%	0,0%	0,0%	0,0%
Construction structures and materials; auxiliary products to construction (except electric apparatus)	0,0%	0,0%	0,7%	0,0%	0,0%