Cross-territorial effects of the implementation of the Italian NRRP

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*Abstract****

The Italian National Recovery and Resilience Plan (NRRP) is expected to generate both long-term structural effects and short-term demand stimuli through public investment. However, the location of NRRP interventions—and therefore the territories expected to benefit from their long-term structural effects—does not necessarily correspond to the location of the firms involved in their implementation and, consequently, to the territories where their short-term economic effects arise. This paper investigates the magnitude and determinants of the cross-territorial effects generated by NRRP-funded public works. Using data from the REGIS and INPS databases, projects are mapped according to both their location and the location of contractors' operational units at the level of Local Labour Market Areas (LLMs). Of the €100.4 billion in infrastructure projects awarded up to February 2026, 72% were assigned to firms located outside the LLM in which the project is implemented, highlighting substantial cross-territorial effects. Multivariate regression models, including aggregate and gravity specifications, are then used to identify the main determinants of these effects. The results indicate that territories with stronger construction-sector capacity retain a larger share of procurement activity and compete more successfully outside their borders, while large tenders and local market stress increase reliance on non-local firms. Gravity-model estimates further show that procurement interactions decline significantly with geographical distance and are stronger between territories with similar socioeconomic and construction-sector characteristics.

Keywords: Italian NRRP; Territorial Effects; Construction Sector; Public Investment; Gravity Model

JEL classifications: H54, H57, R12

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1. Introduction

The National Recovery and Resilience Plan (NRRP) envisages a substantial package of investments and reforms aimed at achieving long-term objectives, particularly by supporting the green and digital transitions and enhancing the country's resilience to external shocks. At the same time, these interventions are expected to pursue, as a cross-cutting objective, the reduction of territorial disparities in infrastructure endowments and growth potential. To this end, through Decree-Law No. 77 of 2021 (the so-called "Simplification Decree"), the Italian government committed to allocating at least 40% of territorially allocable resources, and, consequently, of the corresponding projects, assuming their full implementation, to the regions of Southern Italy (the Mezzogiorno).

The resources earmarked for the eight Southern regions amount to approximately €82 billion, including the Complementary Fund. This requirement appears to have been met: according to the latest Report on compliance with the 40% allocation rule, as of December 2022 the share of resources already allocated, or expected to be allocated, to the Mezzogiorno was equal to or greater than 40% for virtually all NRRP measures examined (Department for Cohesion Policies, 2024).

Alongside these structural effects, NRRP resources progressively deployed for infrastructure projects and for the procurement of goods and services by implementing bodies up to 2026 contribute to short-term economic growth by stimulating aggregate demand through public investment and intermediate consumption. Territorial dimensions are also relevant when analysing the short-term effects of the NRRP. Assuming the full and timely utilization of available resources, SVIMEZ (2023) estimates a cumulative impact on GDP over the 2024–2025 period of 2.5 percentage points in the Mezzogiorno, compared with 2.0 percentage points in Central and Northern Italy.

However, analysing the territorial distribution of the short-term effects of NRRP interventions requires taking into account that the increases in value added and employment generated by NRRP-funded investments may spill over into local production systems other than those where the projects are physically located. These cross-territorial effects arise when the location of NRRP interventions does not correspond to the location of the firms involved in their implementation and, consequently, to the territories where their short-term economic effects are generated.

This paper investigates the magnitude and determinants of the cross-territorial effects generated by NRRP-funded public works. Using data from the REGIS and INPS databases, projects are mapped according to both their location and the location of contractors' operational units at the level of Local Labour Market Areas (LLMs). The analysis highlights the substantial cross-territorial dimension of NRRP-funded public works: of the €100.4 billion in infrastructure projects awarded up to February 2026, 72% were assigned to firms located outside the LLM in which the project is implemented.

The direction and magnitude of construction-work flows across territories are expected to depend on several factors, including local productive capacity in the construction sector, the

intensity of local demand, firms' size distribution, and the characteristics of contracting authorities, such as their scale and institutional quality. To identify the determinants of these cross-territorial effects, the paper employs a set of multivariate regression models. These include an aggregate model, in which the cross-territorial flows associated with each LLM are regressed on a set of covariates referring to the same LLM, and a gravity model, in which bilateral flows between pairs of LLMs are analysed as a function of differences in their socioeconomic and productive characteristics.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature, including contributions from international trade, public procurement, local fiscal multipliers, and fiscal decentralization. Section 3 describes the data on NRRP projects and awarded contractors and presents summary measures of cross-territorial flows. Section 4 illustrates the empirical strategy adopted to analyse the determinants of these effects. The estimation results are presented in Section 5. Section 6 concludes.

2. Related literature

The literature on the territorial effects of public investment has traditionally focused on the estimation of local fiscal multipliers and on the extent to which public expenditure stimulates output and employment in the territories where spending takes place. Recent contributions have shown that these effects may differ significantly across regions and sectors depending on local economic conditions, the cyclical stance of the economy, and the productive structure of the receiving territories. In this perspective, Auerbach and Gorodnichenko (2019) and Nakamura and Steinsson (2014) provide influential evidence on the heterogeneous effects of fiscal shocks across local economies, highlighting how public expenditure may generate sizeable local demand effects through employment creation and the activation of local production chains. More recently, Fiuratti et al. (2024) have extended this approach to the Italian context, analysing the territorial heterogeneity of fiscal multipliers associated with public interventions.

However, the assessment of the territorial impact of public investments financed under large-scale programmes such as the Italian NRRP requires going beyond the traditional local multiplier framework. In particular, it is necessary to consider that the implementation of public projects often involves firms, workers, and supply chains located outside the territories where investments are physically carried out. As a consequence, the increase in aggregate demand generated by NRRP expenditure may partially spill over into different local production systems, producing what may be defined as cross-territorial or spatial effects of public investment implementation. These effects are especially relevant in the presence of strong territorial asymmetries in productive specialization and firm organization, as is the case in Italy.

This paper is also related to the literature on public procurement and the geography of government demand. Herzy and Varela-Irimia (2020), together with the literature reviewed therein, emphasize that procurement systems are not territorially neutral. The geographical distribution of awarded contracts depends on firms' productive capacities, technological

specialization, organizational scale, and administrative capabilities, often leading to a concentration of procurement opportunities in more developed areas. Consequently, public expenditure allocated to lagging regions may generate part of its economic effects elsewhere, through the participation of firms headquartered or operationally located in different territories. This mechanism is particularly relevant for investment-intensive programmes such as the NRRP, where large infrastructure and construction projects frequently involve national firms operating through geographically dispersed operational units and subcontracting networks.

The paper also connects to the broader literature on spatial spillovers and interregional transmission mechanisms of public expenditure. Economic geography and spatial economics have long stressed that production systems are interconnected through trade linkages, labour mobility, and firm networks. Public demand generated in one territory may therefore activate value added and employment in neighbouring or economically integrated areas. In this sense, the territorial effects of public investment cannot be fully understood solely on the basis of the physical location of projects. Rather, they depend on the spatial organization of production factors and on the ability of local economies to absorb the demand generated by public expenditure. The concept of "territorial leakages" becomes particularly important in this context, as it captures the extent to which public resources allocated to a territory are transformed into income and employment outside the target area.

These issues are also indirectly related to the literature on regional fiscal balances and fiscal residua in decentralized and federal systems. Studies such as Turnes and Vence (2026) emphasize that the territorial distribution of public expenditure does not necessarily coincide with the territorial distribution of its economic benefits. The existence of interregional production linkages and cross-border demand effects may substantially alter the effective territorial incidence of public spending, suggesting that conventional measures based exclusively on the location of expenditure may provide a misleading representation of regional redistributive patterns.

Finally, the paper contributes to the literature evaluating the effectiveness of European Cohesion Policy and Structural Funds. A large body of research has investigated whether European funds effectively promote convergence across regions, often focusing on the relationship between allocated resources and local growth outcomes. However, relatively limited attention has been devoted to the possibility that part of the economic stimulus generated by cohesion-oriented investments may spill over into stronger external production systems. The implementation of the Italian NRRP provides a particularly relevant setting to investigate these mechanisms, given both the territorial concentration of many investments and the strong productive asymmetries characterizing the Italian economy.

3. Data

3.1. Pooled dataset

The construction of the dataset involved several steps aimed at integrating two different data sources: the REGIS database, which contains information on PNRR-funded projects, and firm-level data from the INPS administrative archives (Figure 1).[1] Starting from the REGIS database, all NRRP projects are extracted together with information concerning the project identification code, the type of the project and project location. In particular, we focus on public works because they account for a substantial share of NRRP expenditure and are especially exposed to cross-territorial implementation effects. Project locations were reported by the contracting authorities (e.g. municipalities, provinces, regions, and ministries) of the PNRR projects. When a project involves one or more municipalities, the location is the municipality or municipalities concerned together with their corresponding ISTAT codes. When a project covered an entire province, the location was classified as *Provincial Area*; when it covered an entire region, it was classified as *Regional Area*; and when it involved the whole national territory, it was classified as *National Area*.

In addition, all tenders associated with NRRP projects are collected, including the tender identification code (CIG) and the tender amount. Subsequently, the tenders were matched with the main awarded contractors and the subcontractors (VAT number or tax identification code). Through the VAT number or tax identification code, the dataset built in the previous phase is merged with the INPS datasets on workers and social benefit recipients for each firm. Of particular importance in this phase is the collection of information regarding the municipalities of the operational units of the main awarded contractors and the subcontractors of the NRRP projects. The adopted definition of operational unit is the location where the work activity of one or more employees is carried out on a stable basis. Large firms may therefore have multiple operational units located across different areas of the Italian territory.

The dataset is restricted to projects classified as public works. Other types of projects were therefore excluded, including the procurement of goods and services, grants to production units, grants to other entities, and the initial subscription or increase of share capital (including spin-offs), as well as venture capital or guarantee funds. This selection is adopted because public works projects are more directly associated with territorially identifiable economic activity and allow for a more reliable reconstruction of the geographical allocation of awarded contracts and firms involved in project implementation.

According to the REGIS datasets updated as of 26 February 2026, 25,699 projects were classified as public works, accounting overall for 112.639 billion euros in allocated funding and 101.768 billion euros in awarded amounts.[2] These projects cover a wide range of public

[1] The integration of the two datasets was enabled by the VISITINPS PNRR-Labour 2024 research project.
[2] The difference between allocated funding and awarded amounts can be explained by the fact that some procurement procedures have not yet been launched or recorded in the REGIS platform. Several delays in updating the platform have in fact been reported, particularly with regard to smaller tenders.

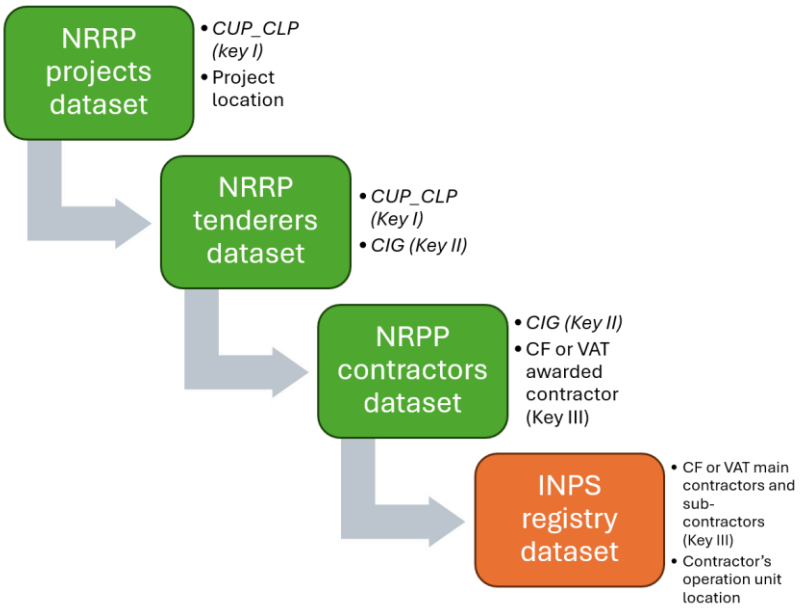
works. As shown in Table 1, railway and metropolitan infrastructure accounts for the largest share of public funding, with €51.96 billion allocated to 299 projects. School buildings represent the largest category in terms of number of projects, with 6,491 interventions and €11.57 billion in public funding, followed by social and healthcare buildings, cultural heritage assets, and nursery schools. Overall, Table 1 highlights the heterogeneity of NRRP public works, which include both large-scale infrastructure projects and a large number of smaller interventions related to education, healthcare, cultural heritage, urban infrastructure, and local public services.

Table 1 - Distribution of PNRR public works projects by type of infrastructure.

Type of public work	Number of projects	Public funding (€ billion)
Railway and metropolitan infrastructure	299	51.958
School buildings	6,491	11.568
Social and healthcare buildings	4,084	9.157
Electricity and gas distribution networks	207	6.653
Water infrastructure	116	6.556
Road infrastructure	1,578	4.277
Environmental infrastructure	1,775	4.065
Cultural heritage assets	3,869	3.622
Nursery schools	2,843	3.330
Other infrastructure	1,578	2.773
Residential buildings and offices	678	2.598
Other transport modes	532	2.590
Sports facilities	744	1.681
Infrastructure for productive and commercial areas	576	1.028
Urban furniture and public lighting	266	0.400
Justice and public security buildings	47	0.357
Hardware and Software	15	0.025
Total	25,699	112,639

Note: Classification by "natura del CUP", "other infrastructure" includes projects not otherwise classified.

Figure 1 – Framework for the integration of NRRP/INPS databases.



3.2 Project location

Each PNRR project was assigned to one or more municipalities. When a single municipality was reported (*municipal-level area*), the entire project was allocated to that municipality. When a project involved multiple municipalities (*multi-municipal area*), the project value was distributed across municipalities proportionally to their resident population according to the latest census. For instance, if a cycleway project involved two municipalities, municipality A (9,000 inhabitants) and municipality B (1,000 inhabitants), 90% of the project value was allocated to municipality A and the remaining 10% to municipality B.

Projects identified at the provincial, regional, or national level were similarly redistributed across all municipalities within the relevant geographical area according to population shares. It should be emphasized that projects implemented by multilevel entities, such as regional governments, were geographically allocated to the areas served by the relevant infrastructure. For example, Community Houses and Community Hospitals, which are projects implemented by regional governments, were assigned to the municipalities whose residents can access the services provided by these facilities.

The majority of public works projects are identified at the municipal level, accounting for 24,227 projects and approximately 50.1 billion euros in financing (Table 2). Projects with a broader-than-municipal location account for only 1,472 projects, but represent about 62.5 billion euros in financing. In particular, regional-level projects (mainly railway infrastructure projects) are limited in number (206 projects) but account for 35.8 billion euros.

Table 2 - Distribution of PNRR public works projects by geographical location typology.

Project location typology	Number of projects	Financing amount (€ million)
Municipal area	24,227	50,138
Multi-municipal area	1,070	12,137
Province area	177	8,099
Regional area	206	35,775
National area	19	6,489
Total	25,699	112,639

3.3 Location of main awarded contractors and subcontractors

The awarded value of each PNRR public works tender, was geographically assigned to one or more municipalities through INPS operational unit.[3] INPS operational unit is the location where one or more employees permanently carry out their work activities, or as a homogeneous production section of the firm. When the awarded firm operated through a single INPS operational unit, the entire awarded amount was allocated to the municipality in which that unit was located. When the awarded firm had INPS operational units located in different municipalities, the awarded amount was distributed across locations according to the distribution of wages, measured by the contribution base for social security contributions, across operational units. For example, suppose firm Alpha operates three operational units: one in Rome (headquarters), one in Milan, and one in Palermo. If wages of the firm are distributed as 60% in the unit of Rome, 30% in the unit of Milan, and 10% in the unit of Palermo, and the awarded amount equals 1 million euros, then 600 thousand euros are allocated to Rome, 300 thousand euros to Milan, and 100 thousand euros to Palermo.

Most awarded firms are associated with a single municipality (Table 3)[4]. A smaller number of firms operate through multiple operational units located in different municipalities; these firms account for more than 12.6 billion euros in awarded amounts.

Table 3 – Geographical distribution of main awarded contractors and subcontractors.

	Awarded amount (€ million)	
	Main contractors	Sub-contractors
Located in a single municipality	81,674	6,148
Located in more than one municipality	12,365	0,278
Total	**94,039**	**6,426**

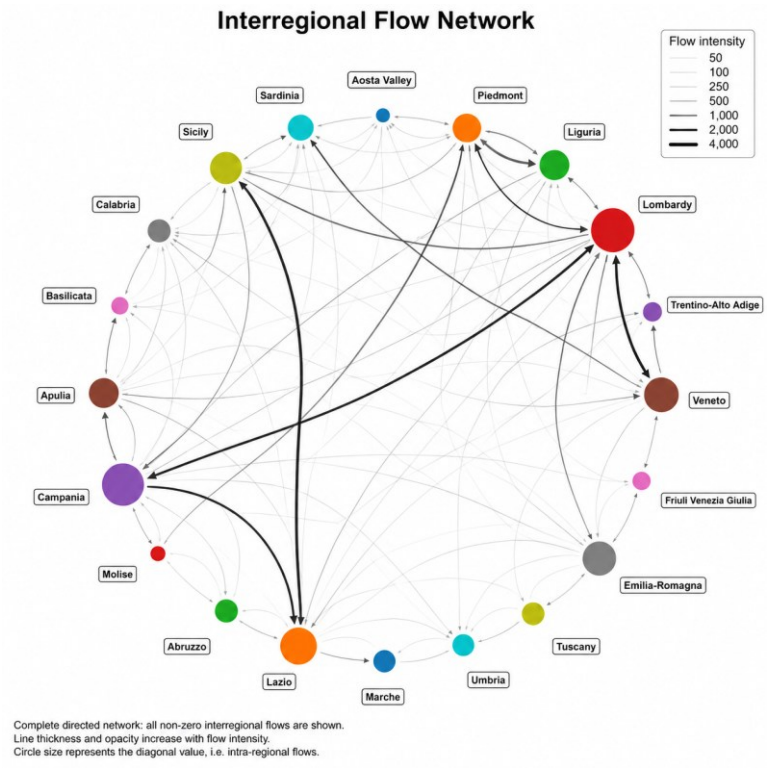
[3] Unfortunately, the allocation of the awarded contract amount between main contractors and subcontractors is unknown; therefore, in cases involving multiple main contractors and subcontractors, the awarded amount has been subdivided on wages for each operation unit.

[4] Approximately 1,000 small firms, corresponding to around 9 million euros in awarded amounts, could not be geographically identified because no matching records were found in the INPS administrative archives.

3.4. Cross-territorial effects

After collecting information on both the geographical location of projects and the location of awarded firms, we combined the two sources in order to reconstruct the flows of NRRP public works awards across different territories. As a preliminary descriptive analysis, for expositional purposes, we focus on cross-territorial effects at the regional level to highlight the existence and intensity of these flows. Figure 2 shows the interregional flows of NRRP award public works, measured in million euros, with a network graph.[5] In Figure 2, the intensity of flows is represented by line thickness and opacity, with stronger interregional flows displayed through thicker and darker lines. The coloured circles near the name of each region represent intra-regional flows, that is, the total value of tenders for projects located in the region and awarded to firms located in the same region. In particular, Lombardy emerges as the main hub of cross-regional awards, receiving substantial flows from projects located in several other regions, especially Campania, Sicily, Veneto, and Lazio. At the same time, the large size of the circles associated with Lombardy, Campania, Veneto, Lazio, and Sicily indicates the presence of substantial intra-regional flows, suggesting that a significant share of public works contracts is still awarded to firms located within the same region as the project.

Figure 2 – Interregional NRPP award public works flows.



[5] We report in Table A1 the detailed structure of NRRP public awards flows through the interregional matrix, where each row represents the region in which the project is located and each column represents the region in which the awarded firm is located.

As a further step of aggregation, the flow matrix can be reduced to a Centre-North/Southern Italy classification (Table 4). As a general object, the NRRP established that at least 40% of territorially allocable resources should be directed to Southern Italy (Mezzogiorno)[6] in order to reduce longstanding territorial disparities between the North and the South of Italy. Table 4 suggests that the 40% target for the allocation of NRRP resources to Southern Italy was broadly achieved when considering only the geographical location of public works projects. Indeed, approximately 41% of the total awarded amount (41.331 out of 100.461 billion euros) relates to projects located in the "Mezzogiorno" regions. However, firms located in the South regions were awarded 28.758 billion euros, corresponding to approximately 29% of the total value of NRRP public works contracts.

Table 4 - Flows of NRRP public works awards between Centre-North and Southern Italy.

Project location/Awarded contractors location	Centre-North	South	Awarded amount (€ million)
Centre-North	45,523	13,628	59,150
South	26,180	15,131	41,331
Total	71,703	28,758	100,461

3.5. Other variables

We additionally collected a set of variables external to both the PNRR database and the INPS administrative archives. These variables were collected at the level of Local Labour Market Areas (LLM) – 2021 classification, as we chose this territorial unit as the relevant level of geographical aggregation. The granular dataset was aggregated at the LLM level because these areas represent relatively self-contained labour markets, characterized by strong internal commuting flows and economic interdependence. This level of territorial granularity allows us to account both for the externalities associated with the use of new infrastructure and for the economic spillovers generated by infrastructure construction activities.

The first external variable collected is the *construction sector stress indicator*.[7] This indicator measures tensions in the public works construction market at the level of each LLM. The construction sector stress indicator is built as a normalized deviation of a proxy for the local demand–supply balance in the construction sector. Demand is proxied by municipal building permits, measured as the total surface area of permits issued in 2022 for new buildings, while supply is proxied by total wages paid in 2022 by firms operating in the construction sector. The ratio between building permits and total construction wages therefore provides an indicator of demand relative to local productive capacity.

The indicator is normalized across LLM as the percentage deviation from the national value, according to the following formula:

[6] The Mezzogiorno area includes the following regions: Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily, and Sardinia.

[7] We focus on the construction market because approximately 80% of awarded contracts were won by firms whose main ATECO classification belongs to sector F (construction activities).

$$\text{Construction sector stress indicator}_{sll} = \frac{\left(\frac{\text{Permits}}{\text{Construction wages}}\right)_{sll} - \left(\frac{\text{Permits}}{\text{Construction wages}}\right)_{national}}{\left(\frac{\text{Permits}}{\text{Construction wages}}\right)_{national}}$$

Higher values of the construction sector stress indicator are associated with stronger demand pressures and therefore higher levels of tension in the local public construction market, whereas lower values reflect relatively weaker demand pressures and a lower degree of market tension.

We also collect at LLM level, the *MAQI* (Municipal Administration Quality Index) indicator. The MAQI is a composite indicator capturing the quality and administrative capacity of local governments in Italy at the municipal level. The index, calculate over the period 2001–2022, combines information on bureaucratic efficiency and administrative capacity, the quality of local political leadership, and the economic and fiscal performance of municipal administrations (Cerqua et al., 2025).

We also include two indicators derived from the FRAME-ISTAT territorial information system. *Employees per firm in the construction sector* measures the average number of employees per construction firm within each LLMA and is used as a proxy for the organizational size and productive structure of the local construction sector. *Wages per employee in the construction sector* measures the average annual wage per employee in construction activities and captures differences in labour costs and productivity across local labour markets.

For each LLM, we also collect *Per capita income*, measured in thousand euros from the Ministry of Economy and Finance (MEF) tax return statistics, using taxable income for municipal and regional surtaxes for the year 2022, and *Population*, in thousands from the 2021 population census.

We additionally collected information on tender size, using LLM as the unit of analysis. The variable *Share of awarded amounts in large tenders* measures the percentage of awarded amounts associated with tenders located within a given LLM whose awarded value exceeds 5.382 million euros. This threshold corresponds to the EU public procurement threshold for works contracts. Contracts above this threshold are subject to EU-wide procurement rules, including stricter transparency, advertising, and competitive tendering requirements. The indicator therefore captures the relevance of large-scale public tenders, which are typically characterized by greater administrative complexity and broader market participation. The total value of contracts awarded through "large" tenders in our sample of public works contracts amounts to 79.081 billion euros, corresponding to approximately 77.6% of the total awarded amounts.

4. Estimation strategy

We employ a gravity model to analyse the bilateral flows of NRRP public works awards across LLM's territories. Gravity models are widely used to study bilateral economic interactions, as they relate the intensity of flows between two territories to their economic

size and the spatial distance separating them. In our framework, the dependent variable captures the value of awarded contracts flowing from territory *i*, where the awarded firm is located, to territory *j*, where the project is located.

The baseline specification is the following:

$$\frac{Awarded\ amount\ flow_{ij}}{rev_i + rev_j} = \beta_0 + \beta_1 D_{ij} + \beta_2 (X_i - X_j) + \alpha_{ri} + \gamma_{rj} + \varepsilon_{ij} \quad (1)$$

where $Awarded\ amount\ flow_{ij}$ denotes the bilateral flow of awarded amounts of public work between the LLM (i) where the awarded firm is located and the LLM (j) where the project is located. Since LLMs differ substantially in their socioeconomic characteristics, *awarded amount flows* are normalized by the sum of construction-sector revenues in the origin LLM and the destination LLM. Specifically, rev_i denotes the total revenues of firms operating in the construction sector in the origin LLM in 2022, while rev_j represents the total revenues of firms operating in the construction sector in the destination LLM in 2022.

Consistently with the gravity-model, greater spatial distance is expected to reduce the intensity of cross-territorial interactions, so whit D_{ij} we capture spatial distance between LLM. In particular, distances are measured as actual travel times between the municipalities identified as the administrative centres[8] of the respective LLMs.

The vector $X_i - X_j$ captures differences in the main socioeconomic and institutional characteristics between origin and destination LLMs. We control for differences across LLMs in construction-sector market tensions, average firm size in the construction sector, per capita income, local administrative quality (MAQI), population, and wages per employee in the construction sector. α_{ri} and γ_{rj} denote origin and destination regional fixed effects, respectively. Robust standard errors are used in all specifications.

5. Results

The gravity model is estimated using the Poisson Pseudo-Maximum Likelihood (PPML) estimator because bilateral procurement-flow data contain a large number of zero observations (60.95%). Unlike log-linearized OLS models, PPML allows zero-valued flows to be retained in the estimation and provides consistent estimates in the presence of heteroskedasticity (Santos Silva and Tenreyro, 2006). Table 5[9] reports the results of the gravity-model estimations using PPML regressions, where the dependent variable is the bilateral flow of awarded amounts normalized by construction-sector revenues in the origin and destination LLMs.[10] In column (1), we report the baseline specification including only the distance variable. In column (2), we add differences in socioeconomic, institutional, and

[8] The municipality serving as the administrative centre generally corresponds to the main functional and employment hub within the LLM namely the municipality attracting the largest share of commuting flows and economic activities.

[9] As a robustness check, we re-estimate the gravity specifications using an OLS model. The results are substantially confirmed, as shown in Table A3.

[10] Summary statistics are reported in Table A2.

construction-sector characteristics between origin and destination LLMs. Column (3) additionally includes origin and destination regional fixed effects, while column (4) introduces the difference in the share of awarded amounts concentrated in large tenders.

Across all specifications, distance displays a negative and highly statistically significant coefficient. The estimates range between −0.388 and −0.433, indicating that spatial frictions substantially reduce cross-territorial procurement flows. This result is fully consistent with the gravity-model framework, according to which economic interactions decline with geographical distance and travel costs between territories.

The difference in construction-sector stress indicators is positively associated with bilateral procurement flows. The coefficient is +0.258 in the fully specified model. This result indicates that procurement flows tend to be stronger between LLMs characterized by larger differences in construction-sector conditions. This pattern is consistent with procurement flows connecting territories with different degrees of construction-market pressure, potentially reflecting the ability of firms located in less constrained markets to respond to procurement demand arising in areas facing greater construction-sector capacity pressures.

Differences in per capita income display a negative and highly significant effect throughout all specifications. The estimated coefficients range between −0.018 and −0.059, indicating that procurement flows are more intense between territories with relatively similar income levels. By contrast, differences in population are positively associated with procurement flows, with coefficients ranging from 0.275 to 0.324. This result suggests that larger asymmetries in market size between territories are associated with stronger procurement interactions, consistent with the presence of agglomeration economies and differences in productive capacity across local markets.

The productive structure of the construction sector also appears to matter. Differences in wages per employee in the construction sector are positively and strongly associated with procurement flows across all specifications, with coefficients increasing from 0.073 to 0.098. This finding suggests that procurement flows tend to connect territories characterized by different productivity and labour-cost structures, possibly reflecting the competitive advantage of firms operating in higher-value construction markets.

Differences in local administrative quality, measured through the MAQI indicator, display a negative but statistically insignificant coefficient.

Finally, column (4) shows that differences in the share of awarded amounts concentrated in large tenders exert a large negative effect on procurement flows (−0.786). This result suggests that procurement integration between territories is substantially lower when local tender structures differ markedly in terms of scale and administrative complexity. Overall, the gravity-model estimates provide evidence that cross-territorial procurement flows are strongly shaped by spatial proximity and by similarities in socioeconomic and construction-sector characteristics across LLMs.

Table 5 – Gravity model results, PPML regression.

Dep. variable: Awarded amount flow on rev.	(1)	(2)	(3)	(4)
Distance	-0.388***	-0.389***	-0.433***	-0.433***
	(0.016)	(0.016)	(0.015)	(0.015)
Difference of construction sector stress indicators		-0.005	0.273**	0.258**
		(0.063)	(0.108)	(0.106)
Difference of income per capita		-0.018***	-0.058***	-0.059***
		(0.004)	(0.009)	(0.009)
Difference of population		0.275***	0.289***	0.324***
		(0.033)	(0.039)	(0.039)
Difference of employees per firm in the construction sector		0.005	0.037	0.017
		(0.033)	(0.038)	(0.037)
Difference of wages per employee in the construction sector		0.073***	0.091***	0.098***
		(0.008)	(0.011)	(0.010)
Difference of MAQI		-0.047	-0.046	-0.020
		(0.109)	(0.150)	(0.145)
Difference of share of awarded amounts in large tenders				-0.786***
				(0.096)
Constant	-14.686***	-14.754***	-14.424***	-14.326***
	(0.053)	(0.057)	(0.138)	(0.138)
Observations	371,490	371,490	371,490	371,490
R-squared	0.078	0.080	0.100	0.100
Origin Regional Fixed Effects	No	No	Yes	Yes
Destination Regional Fixed Effects	No	No	Yes	Yes

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

5. Robustness tests

The main results are substantially confirmed by two robustness checks. First, to eliminate potential arbitrariness arising from the allocation of awarded amounts between main contractors and subcontractors, we re-estimate the gravity model considering only procurement flows directed to main contractors (Table 6). Second, to address potential arbitrariness in the geographical attribution of projects, we restrict the analysis to projects located in a single municipality, for which the territorial allocation of the investment can be unambiguously identified (Table 7). The results obtained from both specifications are broadly consistent with the baseline estimates, confirming the robustness of our main findings.

Table 6 – Gravity model results, only main contractors, PPML regression.

	(1)	(2)	(3)	(4)
Dep. variable: Awarded amount flow on rev.				
Distance	-0.377***	-0.378***	-0.421***	-0.421***
	(0.016)	(0.016)	(0.016)	(0.016)
Difference of construction sector stress indicators		-0.002	0.289**	0.276**
		(0.066)	(0.115)	(0.112)
Difference of income per capita		-0.022***	-0.056***	-0.057***
		(0.004)	(0.009)	(0.009)
Difference of population		0.281***	0.289***	0.326***
		(0.033)	(0.039)	(0.039)
Difference of employees per firm in the construction sector		-0.019	0.016	-0.005
		(0.035)	(0.040)	(0.039)
Difference of wages per employee in the construction sector		0.078***	0.095***	0.102***
		(0.009)	(0.012)	(0.011)
Difference of MAQI		-0.073	-0.097	-0.071
		(0.115)	(0.159)	(0.154)
Difference of share of awarded amounts in large tenders				-0.807***
				(0.100)
Constant	-14.713***	-14.783***	-14.445***	-14.344***
	(0.057)	(0.062)	(0.139)	(0.140)
Observations	371,490	371,490	371,490	371,490
R-squared	0.071	0.073	0.094	0.094
Origin Regional Fixed Effects	No	No	Yes	Yes
Destination Regional Fixed Effects	No	No	Yes	Yes

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

Table 7 – Gravity model results, only projects located in one municipality, PPML regression.

	(1)	(2)	(3)	(4)
Dep. variable: Awarded amount flow on rev.				
Distance	-0.377***	-0.378***	-0.421***	-0.421***
	(0.016)	(0.016)	(0.016)	(0.016)
Difference of construction sector stress indicators		-0.002	0.289**	0.276**
		(0.066)	(0.115)	(0.112)
Difference of income per capita		-0.022***	-0.056***	-0.057***
		(0.004)	(0.009)	(0.009)
Difference of population		0.281***	0.289***	0.326***
		(0.033)	(0.039)	(0.039)
Difference of employees per firm in the construction sector		-0.019	0.016	-0.005
		(0.035)	(0.040)	(0.039)
Difference of wages per employee in the construction sector		0.078***	0.095***	0.102***

		(0.009)	(0.012)	(0.011)
Difference of MAQI		-0.073	-0.097	-0.071
		(0.115)	(0.159)	(0.154)
Difference of share of awarded amounts in large tenders				-0.807***
				(0.100)
Constant	-14.713***	-14.783***	-14.445***	-14.344***
	(0.057)	(0.062)	(0.139)	(0.140)
Observations	371,490	371,490	371,490	371,490
R-squared	0.071	0.073	0.094	0.094
Origin Regional Fixed Effects	No	No	Yes	Yes
Destination Regional Fixed Effects	No	No	Yes	Yes

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

7. Conclusion

This paper shows that the territorial incidence of NRRP-funded public works cannot be inferred solely from the geographical location of projects. A large share of the short-term demand stimulus generated by infrastructure investment is transmitted across territories through the location of awarded firms, revealing substantial cross-territorial effects. The evidence suggests that these effects are shaped by the productive capacity of local construction sectors, the degree of local market stress, the size and complexity of tenders, and spatial frictions. Territories with stronger construction-sector structures are better able to retain procurement activity and to compete in external markets, whereas areas facing high demand pressures or limited productive capacity rely more heavily on non-local firms.

These findings have relevant policy implications. Place-based investment programmes aimed at reducing territorial disparities should consider not only where resources are allocated, but also where the associated economic stimulus is actually activated. Strengthening local productive capacity and improving the design of procurement procedures may therefore be crucial to enhancing the local impact of public investment and limiting territorial leakages.

Future research could extend this analysis in several directions. First, it could investigate more thoroughly whether the determinants of cross-territorial flows differ across specific categories of public works, such as transport, education, healthcare, or environmental infrastructure. Second, a more detailed assessment of the characteristics of contracting authorities and procurement procedures could help identify which institutional and administrative features are most effective in strengthening the local impact of public investment. Third, the perspective of the analysis could be reversed to investigate the factors influencing construction firms' decisions to undertake projects within or outside the territories in which their operational units are located. Finally, our results provide a more appropriate information basis for analysing the territorial short-term macroeconomic effects of public spending programs.

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Appendix

Table A1 – Matrix of the interregional flows, amounts in millions of euro.

	Piedmont	Aosta Valley	Lombardy	Trentino–S,.T.	Veneto	Friuli Venezia Giulia	Liguria	Emilia-Romagna	Tuscany	Umbria	Marche	Lazio	Abruzzo	Molise	Campania	Apulia	Basilicata	Calabria	Sicily	Sardinia	Total
Piedmont	1,208	9	881	74	133	13	3,118	767	183	56	24	993	189	7	1,030	157	43	25	136	20	9,067
Aosta Valley	18	36	4	0	0	0	0	1	1	0	0	2	1	0	9	0	0	0	2	0	74
Lombardy	353	1	5,119	108	439	29	118	841	394	119	61	1,020	181	17	1,985	216	77	64	436	48	11,626
Trentino S.T.	4	0	127	688	260	3	2	20	30	1	1	137	3	0	135	6	17	0	16	0	1,452
Veneto	296	0	3,420	93	1,815	227	123	520	90	85	42	829	85	7	2,332	362	56	23	182	52	10,638
Friuli Venezia Giulia	56	0	222	14	214	348	20	68	18	14	8	53	23	0	90	23	9	10	47	9	1,247
Liguria	137	0	394	42	133	3	1,516	264	129	47	34	790	59	3	274	91	34	17	87	18	4,072
Emilia-Romagna	212	0	993	68	462	12	62	1,876	242	136	70	423	83	25	581	109	86	48	224	92	5,805
Tuscany	223	0	1,075	67	241	9	79	526	999	165	83	522	76	13	758	154	72	28	187	78	5,356
Umbria	44	0	136	8	20	6	9	52	28	301	20	318	40	6	120	19	10	6	25	8	1,173
Marche	127	0	482	35	45	92	31	217	60	73	960	414	86	9	370	82	78	16	135	29	3,340
Lazio	432	0	543	33	213	28	56	303	143	72	45	2,172	222	19	601	247	40	27	86	17	5,300
Abruzzo	133	0	492	52	57	3	40	210	122	81	46	234	479	23	353	36	61	18	101	34	2,576
Molise	44	0	101	8	24	0	9	41	13	22	8	126	35	143	157	24	13	4	24	8	805
Campania	685	0	3,479	54	309	8	98	931	96	103	43	1,479	104	6	3,149	264	75	39	201	228	11,350
Apulia	437	0	1,022	54	194	1	132	750	91	125	41	1,084	55	8	1,034	1,473	189	25	145	52	6,914
Basilicata	34	0	90	5	336	0	7	29	11	17	5	90	18	0	66	47	150	5	30	7	947
Calabria	155	0	1,063	48	108	4	54	187	70	92	44	283	70	18	405	227	77	629	275	41	3,849
Sicily	375	0	1,714	59	230	202	58	1,658	88	103	44	3,724	247	4	576	551	70	75	1,543	66	11,387
Sardinia	236	0	955	49	87	4	50	168	76	183	43	261	69	3	286	173	82	21	179	557	3,482
Total	5,206	47	22,310	1,560	5,321	992	5,583	9,430	2,882	1,795	1,624	14,954	2,124	313	14,311	4,264	1,241	1,080	4,062	1,364	100,461

Table A2 - Summary statistics, gravity model.

	(1)	(2)	(3)	(4)	(5)
	N	Mean	Standard deviation	Min	Max
Awarded amount flows	371,490	0.00012	0.0014823	0	0.616
Awarded amount flows (only main contractors)	371,490	0.00012	0.0015768	0	0.675
Difference of construction sector stress indicators	371,490	0	0.1983364	-1.150	1.150
Difference of employees per firm in the construction sector	371,490	0	0.829	-6.957	6.957
Difference of income per capita	371,490	0	0.00499	-0.0161	0.0161
Difference of MAQI	371,490	0	0.134	-1.071	1.071
Difference of population	371,490	0	0.378	-3.901	3.901
Difference of wages per employee in the construction sector	371,490	0	4.890	-31.15	31.15
Distance	371,490	401.5	223.1	8	1,023
Difference of share of awarded amounts in large tenders	371,490	0	0.232	-0.860	0.860

Table A3 – Gravity model results, OLS regression.

	(1)	(2)	(3)	(4)
Dep. variable: Awarded amount flow on rev.*1,000				
Distance	-0.037***	-0.037***	-0.051***	-0.051***
	(0.002)	(0.002)	(0.002)	(0.002)
Difference of construction sector stress indicators		0.003	0.037***	0.039***
		(0.008)	(0.011)	(0.011)
Difference of income per capita		-0.002***	-0.008***	-0.008***
		(0.000)	(0.001)	(0.001)
Difference of population		0.052***	0.053***	0.057***
		(0.007)	(0.008)	(0.008)
Difference of employees per firm in the construction sector		-0.001	0.001	-0.001
		(0.004)	(0.004)	(0.004)
Difference of wages per employee in the construction sector		0.009***	0.011***	0.012***
		(0.001)	(0.001)	(0.001)
Difference of MAQI		-0.001	-0.011	-0.004
		(0.015)	(0.016)	(0.016)
Difference of share of awarded amounts in large tenders				-0.079***
				(0.011)
Constant	0.270***	0.270***	0.330***	0.341***
	(0.008)	(0.008)	(0.027)	(0.027)
Observations	371,490	371,490	371,490	371,490
R-squared	0.00	0.00	0.01	0.01
Origin Regional Fixed Effects	No	No	Yes	Yes
Destination Regional Fixed Effects	No	No	Yes	Yes

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