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Public capital and institutions' quality in the Italian regions

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Abstract

This paper investigates the role played by public capital on the production level of Italian regions by specifically accounting for the quality of institutions. Our analysis, carried out over the period 2000–2019, benefits from a rich data set on public expenditures. This allows us to build the regional public capital stock by distinguishing among public institutions in charge of the investments and sectors of intervention. While controlling for several contextual variables (human capital, technological capital, and population density), the main results show that public capital has a positive and significant effect on production. Most interestingly, looking at Mezzogiorno's regions, public capital carried out by local institutions turns out to have a lower impact than in the rest of the Italian regions. On the other hand, central bodies in the South exhibit an impact higher than the average. Moreover, institutions' quality exhibits a positive and significant effect on regional economic performance. These results cast serious doubts about the local Southern administrations' capacity to effectively manage the National Recovery and Resilience Plan's enormous resources and the new European Union cohesion framework 2021–2027. Our results are also relevant for other European regions that, featuring structural traits similar to Southern Italian regions, are expected to face the same difficulties in managing public funding.

1 | INTRODUCTION

In the next years, Italy is expected to receive a vast amount of public funding (almost 280 billion euros) from the National Recovery and Resilience Plan (NRRP) for Italy and the new European Union (EU) Cohesion Framework 2021–2027. These plans aim to finance structural reforms to boost the economy by accelerating the green and digital transition and removing barriers to market competitiveness and access to essential services, primarily healthcare, and education. It is important to remark that the regional and local administrations will manage a large share of the available financial resources. Moreover, almost half of the funding will be allocated to the eight less-developed Italian Southern regions. From a back-of-the-envelope calculation, Mezzogiorno's regions are expected to allocate and spend almost 94 billion euros from the NRRP and 30 billion euros from the EU framework in the next 5 years. An amount of money they have never received before.

In this context, a relevant question raised by political analysts and policymakers is about the actual capacity of the Southern administrations to deal with such an extraordinary task. Some doubts about the capability of the local public bodies in the Mezzogiorno to manage and efficiently spend these financial resources have also been advanced by economists because of the low quality of the local institutions (Albanese et al., 2020; Di Caro & Fratesi, 2022).

More generally, in the last decade, the economic literature has devoted increasing attention to the impact of the EU cohesion policies on the regional economic outcomes. Many studies have highlighted an overall positive role of the European structural funds. At the same time, some of them have emphasized the large degree of heterogeneity of the impact across territories depending on the quality of the regional institutions and the human and social capital endowments (Crescenzi & Giua, 2020; Dall'Erba & Fang, 2017; Rodríguez-Pose & Ganau, 2022).

More specifically, Rodrìguez-Pose (2020), in an inspiring overview of the open issues on the relationship between institutions and territories, highlights that local institutions may have a direct and an indirect effect on regional economic performances. Local institutions leverage the provision of public goods (education, innovation, infrastructures) in their regions, thus directly affecting their economic performance. Moreover, local administrations play a pervasive role in setting the normative and regulatory framework, and consequently, they influence firms' productivity (Lasagni et al., 2015). At the same time, they have indirect effects given their influence on the local effectiveness of other national or European policies (Rodríguez-Pose & Garcilazo, 2015).

The literature on the EU structural funds' effectiveness is strictly related to the earlier debate on public capital's impact on economic performance originated from Aschauer (1989) and Munnell (1990) contributions. Over the last two decades, the literature on public capital has flourished through cross-countries and regional analyses. Results show a positive effect of public capital on economic outcomes, whose intensity varies depending on the development level and characteristics of the economies (see the meta-analyses by Bom & Ligthart, 2014; Núñez-Serrano & Velázquez, 2017).

This paper aims to contribute to the current debate on public capital effectiveness by distinguishing among the government levels responsible for the expenditure (central and local bodies) and explicitly considering local institutions' quality. Although institutional quality is getting more and more attention within the regional economic literature, accounting for the diversified role played by different government levels has been largely overlooked, especially for the limited availability of data.

The empirical analysis focuses on regional economic performance in Italy over the past two decades that, featuring a persistent divide between the Northern and the Southern regions of the country, represents a relevant case to analyze the relationship between public capital impact and the role played by different institutional levels. To this aim, we first set up a novel database on public capital at the regional level using the investment expenditures of the Extended Public Sector (Settore Pubblico Allargato, SPA) provided by Territorial Public Accounts (Conti

Pubblici Territoriali, CPT). Following the methodology proposed in Marrocu and Paci (2010), we build the series on public capital stock for 21 NUTS2 Italian regions over the period 2000–2019, disaggregated by five levels of institutions responsible for the investments' implementation and by 29 economic sectors.

It is important to remark that this database provides a comprehensive measure of public capital, including all investment expenditures by national and local administrations and public companies. A noticeable share of these public investments is financed through EU structural funds, which are jointly deployed at the regional level along with other funding sources. Therefore, by estimating the overall effect of public capital, our analysis improves on previous literature that focused exclusively on the impact of EU structural funds but neglects the concurrent effects generated by the other important components of public capital funding.

As discussed above, this article devotes specific attention to the quality of the local institutions since they influence the public capital impact on regional economic outcomes. Indeed, almost half of the public capital expenditures in Italy are managed by local administrations or by local public companies. Moreover, this share is likely to increase due to the availability of the NRRP funds. Therefore, the issue of institutional quality is becoming even more crucial, especially in the less-developed regions of Mezzogiorno.

Our econometric specification is based on a standard Cobb–Douglas production function augmented with a measure of the institutions' quality and other intangibles and territorial factors and considering different levels of disaggregation of the public capital. We adopt an instrumental variable approach to deal with the issue of potential endogeneity of the main productive inputs.

The main results highlight the positive impact of public capital on regional product levels with an elasticity higher than the private one. Another remarkable result is that the quality of institutions' variable exhibits the expected positive and significant elasticity, robust to all different specifications. When we disaggregate public capital into *central* and *local* bodies, according to the administrative entities in charge of the expenditures, significant differences between Center-Northern and Southern regions emerge. Central bodies in the Southern regions exhibit an elasticity much higher with respect to the Northern ones. The opposite happens with the local bodies, which appear much less effective in the Southern regions. This finding is mainly due to the fact that the effectiveness of local bodies is a positive function of the level of institutional quality.

Although our analysis focuses on Italy, our results are also relevant for the rest of the European regions, which feature varying levels of institutional quality. In some countries (e.g., Romania, Bulgaria, Hungary, or Greece), institutions responsible for the management and allocation of public funding have a quality level very similar to the one exhibited by the Southern Italian regions.[1]

The rest of the paper is organized as follows. In Section 2 the literature on public capital impact is briefly reviewed. Section 3 deals with the construction and description of the public capital stock series. Section 4 presents the empirical model and a descriptive analysis of the main variables. The econometric results are discussed in Section 5, and Section 6 concludes.

2 | PUBLIC CAPITAL AND ECONOMIC PERFORMANCE

The impact of public capital on the economic performance of states and regions is increasingly seizing the attention of academic researchers and policymakers alike. In addition to the traditional approach on the effects of public capital and infrastructures, a new stream of the literature has explicitly focused on the impact of public expenditures resulting from the EU structural funds.

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[1]According to the European quality of Government index in 2021, the Italian Mezzogiorno has an index of −1.47, Bulgaria and Romania have very similar values (−1.47 and −1.48, respectively), Hungary and Greece a slightly higher one, −1.18 and −1.13. Note that the index ranges from −1.48 (Romania) to 1.68 (Finland).

The first approach on the impact of public capital on production has widely developed after the original contribution by Aschauer (1989). The initial studies (Aschauer, 1989; Munnell, 1990; Sturm & de Haan, 1995) provided questionable estimates of the public capital elasticities because of unsolved econometric issues, such as reverse causality and spurious correlation (Holtz-Eakin, 1994; Romp & De Haan, 2005). In a meta-analysis based on 578 estimates from 68 studies for 1983–2008, Bom and Ligthart (2014) have found an average elasticity of 0.11, showing a major impact of infrastructures realized by the local and regional levels of government. More recently, Núñez-Serrano and Velázquez (2017), in a meta-analysis based on almost 2000 elasticities from 145 studies, found an average elasticity of 0.13 and 0.16 for the short-term and long-term, respectively.

Over the last two decades, the literature on public capital impact has prospered through cross-countries and within-country analysis. The latter studies have proven the positive effect of public capital on economic growth in developed (Fournier, 2016; Han et al., 2017; Kamps, 2004) and developing countries (Agénor & Neanidis, 2015; Gupta et al., 2014; Santiago et al., 2020).

Numerous analyses have studied the impact of public capital stock at the regional level, with specific attention to the case of Spain and Italy. In Spain, a positive effect of public capital has been estimated on economic growth by Moreno et al. (2015) and productivity levels by Gómez-Antonio and Fingleton (2012). Furthermore, Aray (2019) found a positive effect of decentralization on the allocation of public infrastructures. In Italy, several contributions have estimated a positive impact of public capital on economic performance. Marrocu and Paci (2010) remarked a higher elasticity in the Northern regions, and Daniele (2009) showed similar results studying public expenditures. The role of public investments in Southern Italy has been analyzed by Papagni et al. (2021), finding a positive impact only between 1951 and 1973. Moreover, Cosci and Mirra (2018) revealed that postwar public investments in road infrastructures had not reduced the economic divide between Northern and Southern Italy.

A second approach has focused on the impact of capital expenditure originated by the European structural funds. The EU has developed its cohesion policies to encourage and support the integration process among the country members by fostering economic growth and promoting development in the less-developed regions. It is important to remark that the EU cohesion policies have gained relevance in the last years. The capital transfers from the EU and other international institutions to the Italian regions have increased by 23% between 2000 and 2019, and now they represent 28% of the regions' capital expenditure. Therefore, many researchers have analyzed the impact of EU capital expenditure on economic growth and regional integration. While some contributions highlighted the overall positive influence of such policies, others have emphasized the heterogeneity of these effects across countries (see the meta-analysis by Dall'Erba & Fang, 2017). Several authors report that the regional differences depend on national and regional contextual factors, such as the quality of local institutions and the endowment of human capital (Albanese et al., 2021; Di Caro & Fratesi, 2022). Looking at the national intervention model, Crescenzi and Giua (2020) found that EU programs are more effective in enhancing economic growth in Germany, while their impact is weak in the Southern European regions. This result is coherent with Albanese et al. (2020), who estimated an average null effect of EU structural funds on Southern Italy total factor productivity. On the other hand, Coppola et al. (2020) indicated a positive impact of EU cohesion policies in Italy.

In general, the literature highlighted the relevant role of public infrastructures financed through EU cohesion policies. More importantly, sound evidence has been provided on the fundamental role played by the quality of local institutions in favouring the impact of public capital expenditure on economic performance.

3 | PUBLIC CAPITAL STOCK AT THE REGIONAL LEVEL

3.1 | Construction of public capital stock series

The data on public capital stock is not available in Italy at the regional level. The Italian National Institute of Statistics (Istat) provides data only for total capital stock at the national level without distinguishing between private

or public expenditure.[2] Therefore, to obtain the series of regional public capital stock, we accomplish the following steps: (i) compute the series of total regional capital stock, (ii) compute the regional capital stock for the public component, and (iii) decompose total capital in its public and private components.

The initial value of the capital stock in 1999, which represents the base for the series' reconstruction, is computed considering the annual mean value of the national total capital stock for 1996–1999. Then, we divide the national stock in the base year 1999 among the regions using the methodology in Gleed and Rees (1979), also used by Marrocu and Paci (2010). More specifically, the regional capital stock value is based on the regional share of investments (weight 0.75) and labor units (weight 0.25) in the preceding 4 years. Next, the total capital series for each region has been computed for the period 2000–2019 by applying the perpetual inventory method, which entails that the value of the capital stock at time t is equal to the value at time $t - 1$, augmented by investment measured at time t and diminished by depreciation (we assume a 10% depreciation rate). Regional data on gross fixed investment, published by Istat, are in constant prices.

The second step entails constructing the public capital series using the investment expenditures of the Extended Public Sector (SPA). It is important to remark that the SPA includes public administrations and public companies, thus allowing for a more comprehensive assessment of the public investments' impact on the economy. The CPT database has been provided by Territorial Cohesion Agency, and it contains data for capital expenditure categories disaggregated into 29 activity sectors.

It is worth remarking that we consider a broad definition of public investments in this paper. In addition to the categories "real estate assets and works" and "movable property, machinery," we also include "capital transfers to households and social institutions" and "capital transfers to private undertakings." In such a way, our definition of public capital embraces the capital expenditures financed by the public sector, although the investment is realized by private entities.

The SPA data set distinguishes five bodies responsible for the investments' implementation. The "central administration" includes the Italian State and government agencies, such as the Revenue Agency, Cassa Depositi e Prestiti, and Azienda Nazionale Autonoma delle Strade, the national agency for roads. The "regional administration" encompasses the regional government and the local health units. The "local administration" embraces municipalities, provinces, and other territorial entities, such as municipalities' unions, universities, port authorities, and national parks. The "national public companies" include firms under the direct control of the government. Often, they are former public monopolies transformed today into private companies, listed on the stock exchange, but where the State still owns a relevant share.[3] Finally, the "local public companies" level comprises firms owned by the regional and local administrations, usually operating in local public services (water, transports, and energy) and agrarian consortiums and cultural foundations.

This disaggregation is crucial for our analysis, which aims to investigate whether the impact of public capital depends on the level of government responsible for the expenditures. As before, the public capital stock series have been constructed using the perpetual inventory methodology with a 10% depreciation rate from 2000 to 2019. The initial value of regional public capital has been computed using the annual average share of regional public investments on regional total investments between 1996 and 1999. Following the same methodology, we have also obtained a series of public capital stock disaggregated into economic sectors and levels of government.

Finally, in the third step, we compute the private capital component as the difference between total and public capital.

To check whether our calculation of public capital based on CPT data sounds reliable, we compare our national series with the one computed by IMF (2017), which is based on National Accounts data. IMF shows that in Italy, over the years 1999–2014, the share of public capital stock over the total is equal to 22%. This estimate is very similar to the share (24%) we have computed using the broad definition of public investment, including physical

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[2]See Table A1 in the Supporting Information Appendix for data definitions and sources.

[3]Notable examples are ENI (the energy company), ENEL (the electrical company), Poste Italiane (the postal service), and Ferrovie dello Stato (the railway company).
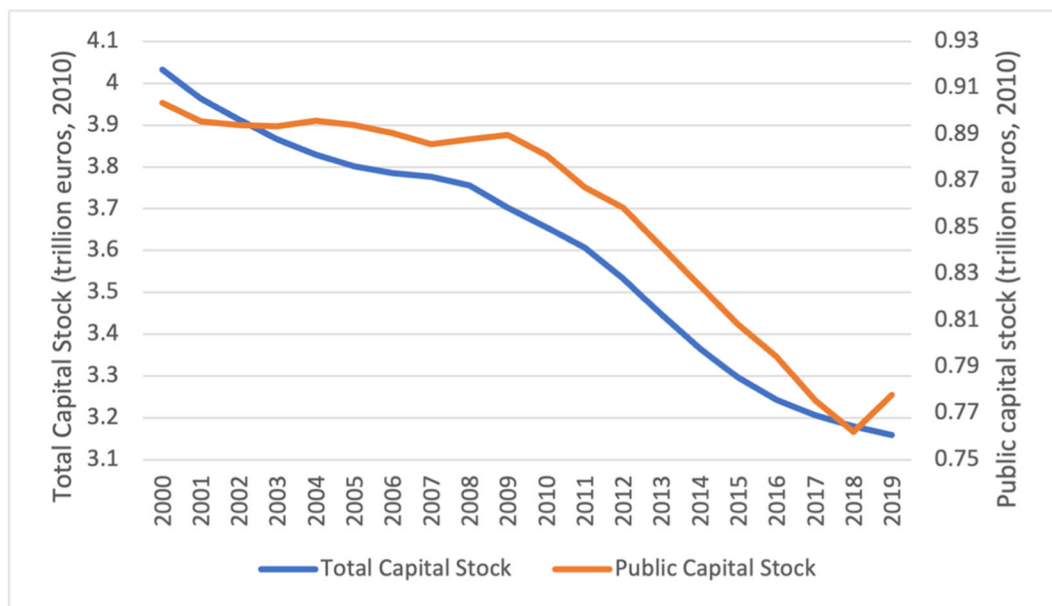
FIGURE 1   Total and public capital stock in Italy, 2000–2019.

works, machinery, and capital transfers to households and firms. On the basis of this result, we focus on the broad definition of public capital in the empirical analysis since it appears more coherent with the National Accounts.

3.2 | Descriptive statistics of public capital series

Figure 1 displays Italy's total and public capital stock series over the years 2000–2019. The total capital stock decreased at a notable rate (−1.28% yearly) during the observed period. The decline in the capital accumulation process appears even more pronounced after the financial crisis of 2008. On the other hand, the level of public capital remains almost unchanged until 2009 and starts decreasing afterwards.

Table 1 reports the share of the public over total capital stock and some summary measures for the public stock of capital, namely, index numbers for per capita and per unit of labor.[4] In general, the share of public capital expenditure over the total is persistently increasing, and it reaches the value of 24.6 in 2019. The public component of the capital stock is more relevant in Southern Italy (36% in 2019). Public capital per labor unit is higher in Southern Italy even if they decrease over time, while they increase in the rest of the country. Figure 2 represents the regional shares of public capital (panel 1), the regional public capital per labor unit (panel 2), and the regional per capita public capital (panel 3) in 2019. The maps show important differences between Northern and Southern Italy in both cases. Together with the small autonomous regions in the Alpes, the Southern regions show a much higher presence of public investment.

Table 2 describes, for the years 2000 and 2019, the share of public capital stock for the five levels of government responsible for the capital expenditure. Interestingly, local administrations in the North show the highest share of public capital in 2000, while in Southern and Central Italy the highest shares are exhibited by the central administration and national public companies. It is worth remarking that the role of the national public

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[4]The full list of the Italian regions and their macroareas are reported in Table A3 in the Supporting Information Appendix.

TABLE 1 Public capital stock by macroareas.

	North		Center		South		Italy	
	2000	2019	2000	2019	2000	2019	2000	2019
Share on total stock (%)	17.0	19.5	22.2	26.1	33.9	36.1	22.4	24.6
Per labor unit (index)	82	88	97	99	133	124	100	100
Per capita (index)	92	98	103	107	108	99	100	100
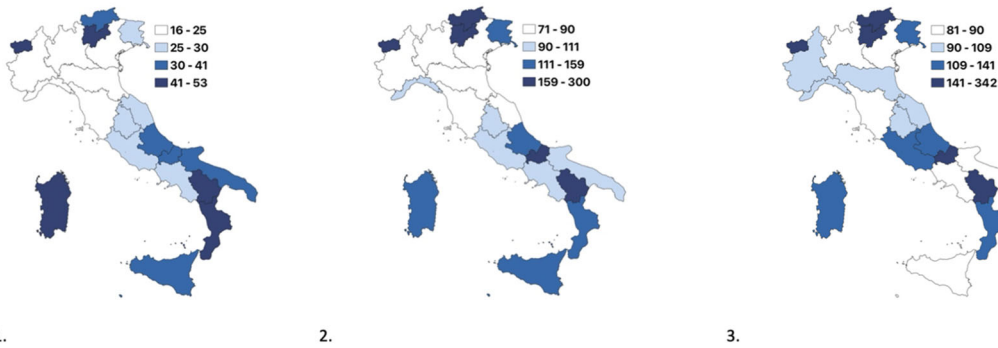
FIGURE 2 Regional distribution of public capital, 2019. (Panel 1) Public capital shares on total capital, (Panel 2) public capital per labor unit (index, Italy = 100), and (Panel 3) public capital per capita (index, Italy = 100).

TABLE 2 Public capital stock by institutions and macroareas (% share).

		North		Center		South		Italy	
Bodies	Macrobodies	2000	2019	2000	2019	2000	2019	2000	2019
Central administrations	Central	16.2	15.7	25.3	23.6	34.4	24.0	25.1	20.1
National public companies	Central	22.0	33.0	28.2	41.7	16.4	35.5	21.0	35.7
Regional administrations	Local	16.8	12.8	7.6	5.4	15.8	12.6	14.6	11.2
Local administrations	Local	31.6	23.2	27.8	19.2	27.4	22.4	29.2	22.1
Local public companies	Local	13.4	15.3	11.2	10.1	6.0	5.4	10.1	10.9

companies has strongly increased over time, and in 2019 they manage 36% of national public capital expenditure. On the other hand, the role of local, regional, and central administrations decreases over time (by −7, −3, and −5 percentage points, respectively). The considerable differences in the share of local public companies among the areas are also interesting: They play a relevant role in the North (15% in 2019) while they control a small share of public capital stock in the Southern regions (5% in 2019).

Table 3 reports the average shares over the years 2000–2019 of public capital stock for the five institutional levels for each region. As expected, the highest share for the regional administrations is shown by the six territories granted an autonomous status, like, Trento (47%), followed by Bolzano, Valle d'Aosta, Sardegna, Sicilia, and Friuli-Venezia Giulia. Considering the whole period, central administrations play a key role in Southern regions, with Calabria showing the highest share, followed by Campania. National public companies exhibit a high capital expenditure in the Central regions (especially in Lazio and Toscana), whereas they play a limited role in Southern Italy. Finally, local public companies have an

TABLE 3 Public capital stock by institutions and regions (% share, average 2000–2019).

Region	Central administration	Regional administration	Local administration	National public companies	Local public companies
Piemonte	18.8	13.7	28.2	30.5	8.9
Valle d'Aosta	6.9	37.7	20.0	13.4	22.0
Liguria	22.8	6.8	31.3	28.5	10.6
Lombardia	17.1	9.4	30.1	26.4	17.0
Province Bolzano	3.7	43.9	27.9	9.8	14.7
Province Trento	5.7	46.6	26.0	8.5	13.3
Veneto	16.6	12.2	30.1	25.3	15.8
Friuli Venezia Giulia	10.7	22.6	31.2	20.9	14.5
Emilia Romagna	14.8	11.5	26.3	28.9	18.6
Toscana	16.1	10.7	29.3	32.4	11.5
Umbria	21.1	8.1	39.5	21.9	9.4
Marche	16.0	11.8	34.8	27.7	9.7
Lazio	30.8	3.3	18.9	35.5	11.5
Abruzzo	31.1	13.8	28.8	19.6	6.7
Molise	28.9	14.1	26.8	25.1	5.2
Campania	32.0	11.0	32.2	17.0	7.8
Puglia	31.0	9.0	25.6	29.9	4.6
Basilicata	29.7	14.8	24.2	27.1	4.2
Calabria	44.3	7.3	24.5	21.3	2.6
Sicilia	26.5	23.6	21.1	22.5	6.3
Sardegna	23.2	25.9	25.2	18.2	7.5
North	15.48	15.65	28.87	25.05	14.95
Center	24.21	6.77	25.27	32.65	11.10
South	30.68	15.35	26.19	21.79	5.99
Italy	22.69	13.70	27.16	25.44	11.01

essential role in Northern regions, like, Emilia Romagna, Lombardia, and Veneto, where companies owned by local administrations control a large part of local public services, like, transport, water, and energy.

CPT data distinguishes between 29 sectors, which have been aggregated into five macrosectors to allow for a more tractable and meaningful analysis (see Table A2 in the Supporting Information Appendix for the complete list).[5] Table 4 displays the percentage share of public capital stock for the different economic macrosectors series in the starting (2000) and final (2019) years. Considering the whole period, the production sector is the main

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[5]The five macrosectors are: "general" sector (includes general public services, public order, justice administration, health, and social welfare); "intangibles" sector (education, R&D, culture, and recreational services); "infrastructures" (transports and telecommunications); "environment" (waste disposal and integrated water service); "production" (sectoral economic activities).

TABLE 4 Public capital stock by macrosectors (% share).

	North		Center		South		Italy	
	2000	2019	2000	2019	2000	2019	2000	2019
General	23.4	18.3	25.6	19.8	22.3	18.4	23.4	18.7
Intangibles	11.4	9.9	11.8	9.1	9.7	8.5	10.8	9.2
Infrastructures	29.4	27.3	31.2	25.6	23.0	22.7	27.3	25.4
Environment	9.2	7.6	7.9	6.2	8.2	6.7	8.6	7.0
Production	26.5	36.9	23.6	39.4	36.8	43.7	29.9	39.7

component of public capital stock in Italy (32%) and its share increases over time (+10 percentage points between 2000 and 2019). Northern and Central Italy display a similar composition of public capital with a prominent and increasing role played by the production sector (respectively, 36.9% and 39.4% in 2019) and relevant percentages for infrastructures (respectively, 27.3% and 25.6%). In contrast, the production sector is prominent (43.7%), and infrastructures account for a much lower proportion (22.7%) in the Southern regions.[6]

Overall, a highly differentiated picture among the regions emerges regarding the government levels responsible for capital expenditures and the sectoral distribution of the capital expenditures. We will consider this heterogeneity in the econometric analysis.

4 | PRODUCTION FUNCTION MODEL AND DATA

4.1 | The model

The role of public capital in the Italian regions over the period 2000–2019 is assessed by estimating a Cobb–Douglas production function considering different levels of disaggregation of the total capital stock and including a set of controls for the intangible factors and territorial characteristics of the regions. The general formulation of the model is

$$Y_{it} = A_{it} L_{it}^{\alpha} K_{it}^{\beta} e^{\varepsilon_{it}}, \tag{1}$$

where the subscript i indicates the region, while t refers to the time period; Y is the regional value added (VA) in constant prices 2010, L is units of labor, K is the total capital stock; A represents the total efficiency level.

As argued in the previous sections, the total factor productivity is assumed to depend on the Quality of Institutions (QI), because it exerts a pervasive role in driving economic outcomes, especially when public bodies are directly involved in investment decisions and indirectly by setting the normative and regulatory framework. Moreover, to control for regional heterogeneity, we consider three immaterial factors: the endowments of human capital, social capital, and technological capital, which play a decisive role in enhancing the effectiveness of production inputs. Population density is also included to take into account demographic trends and possible agglomeration effects. All the exogenous variables are included with a 5-year lag, which allows us to consider a period long enough for the contextual variables to exert their effects on the dependent variable and guard against the potential problem of reverse causality.

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[6]The sectoral shares at the regional level are reported in Table A3 in the Supporting Information Appendix.

As discussed in Section 3, the total capital stock can be disaggregated into private and public capital. The latter can also be split up according to the bodies in charge of carrying out the investments and to the sectors of activity.

The empirical specification is obtained by the log-linearizing model (1) and accounting for the lag structure discussed above:

$$\ln(Y_{it}) = \alpha \ln(L_{it}) + \beta \ln(K_{it}) + \delta \ln(QI_{it-5}) + \gamma South_i + \lambda_t + controls_{it-5} + \varepsilon_{it}. \quad (2)$$

To deal with the issue of potential endogeneity of the main productive inputs, we adopt an instrumental variable approach and the Two Stage Least Squares (2SLS) estimation method. Following Reed (2015) and the common practice usually adopted when it is very difficult to find valid external instrumental variable, we resort to the internal ones; hence, labor and capital stock are instrumented by their own lagged variables in all the estimated models. It is worth noting that lagged variables could not be valid instruments if they are correlated with unobserved confounders (Bellemare et al., 2017), to attenuate this problem we have considered lags of 5 years. Although the choice of such a long lag comes at the cost of reducing the estimation sample size, it allows us to tackle more effectively endogeneity threats with respect to the case of shorter lags.[7] Notwithstanding such considerations, all the estimated effects have to be interpreted with great caution.

In a preliminary analysis we considered estimating model (2) by including regional fixed effects. However, such specification resulted in all coefficients of the explanatory variables being not significant at conventional levels. This could be due to the small time dimension of the panel and to the fact that most explanatory variables exhibit persistent cross-region variation.

To take into account the time-invariant divide between the Center-North and the Southern areas, we include a dummy variable *South* that takes the value of 1 for the eight Southern regions.[8] Finally, time dummies (λ_t) are included to account for common shocks at the macroeconomic level.

Before presenting and discussing the main empirical results in Section 4.2 we provide a detailed description of the most salient features of the variables used in our analysis other than the stock of capital, which has been already described in Section 3.2.

4.2 | Data

We start by providing a statistical description for the dependent variable, regional VA, followed by institutional quality and the main contextual variables, namely, human capital, social capital, and technological capital. Table 5 and Figure 3 report the summary statistics of all the variables while the complete list of the variables and their sources is reported in Table A1 in the Supporting Information Appendix.

The Italian VA series shows a sharp decrease after the financial crisis of 2008 (−5.4% between 2008 and 2009) and after the Italian debt crisis of 2011 (−4.2% between 2011 and 2013). Looking at the per capita VA, the Southern regions are well below the national average (index 61 in 2019), while Northern Italy has an average value 13% higher than the national one, confirming the huge and even increasing economic differences between the two areas.

In the econometric analysis, as factors influencing the economic performance at the regional level, we consider the intangible assets whose effect on the production has been largely documented in the empirical literature on regional economic growth. Among them, we devote specific attention to the Quality of the Institutions since a large share of public investment is implemented at the local level by administrations and public companies. Seminal

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[7]We have also estimated the models with using as instruments for labor and capital stock variables and their 6-year lagged values. The results remain unchanged.

[8]In a preliminary analysis we also included a dummy variable for the 9 Northern regions, however no significant differences were found with respect to the reference group of regions, that is, the four Center ones.

TABLE 5 Descriptive statistics, indices (Italy = 100).

	North		Center		South	
	2000	2019	2000	2019	2000	2019
Value added (per capita)	113	113	105	102	63	61
Quality of institutions[a]	135	132	112	118	54	55
Human capital	98	106	116	121	92	81
Social capital[b]	131	127	96	97	61	66
Technological capital	102	110	129	110	70	65

[a]Initial year, 2004.
[b]Final year, 2018.
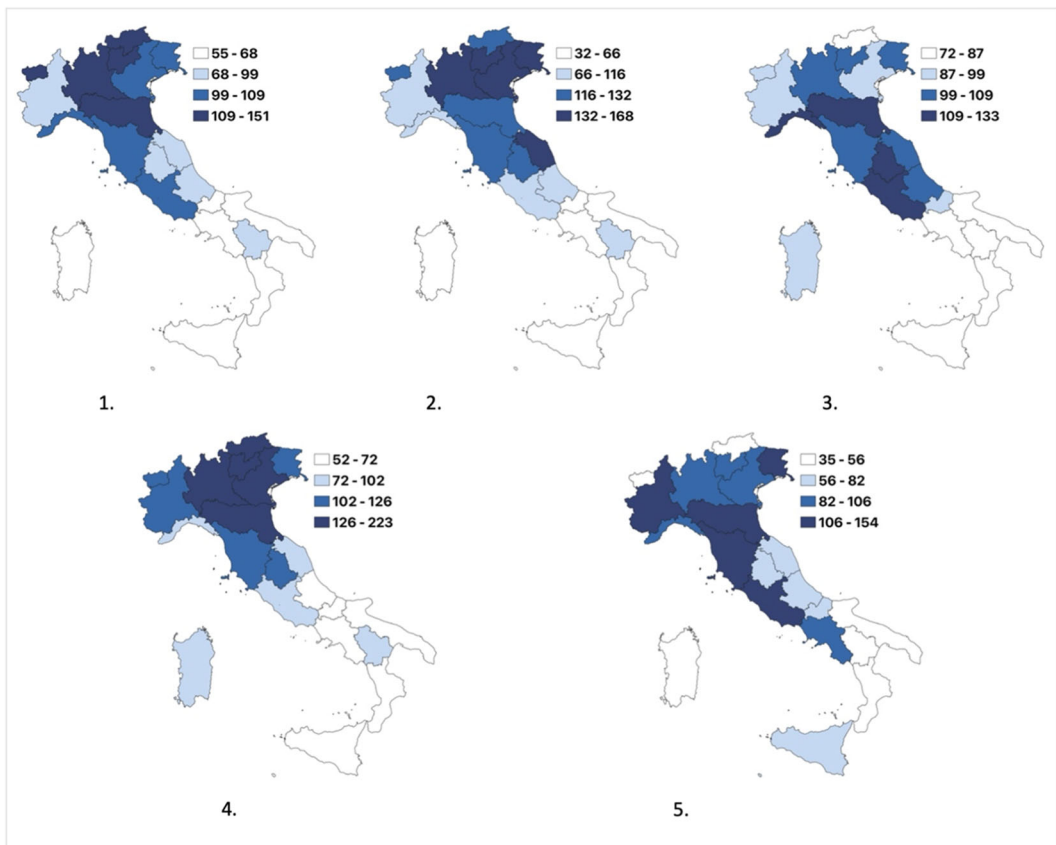
FIGURE 3 Regional distribution of main variables, 2019 (indices, Italy = 100). (1) Value added per capita, (2) quality of institutions, (3) human capital, (4) social capital, and (5) technological capital.

contributions have emphasized the role of institutions in determining the performance of economic systems (among others, Acemoglu et al., 2001; Glaeser et al., 2004; North, 1990). A high-quality government ensures the provision of more efficient public services, thus supporting local economic development. More recently, the growth-enhancing effect of institutions at the regional level has been remarked by Rodríguez-Pose, (2013) and Rodríguez-

Pose and Ganau (2022). In this paper, we use the QI index computed by Nifo and Vecchione (2014) as a composite index based on various measures of corruption, government effectiveness, regulatory quality, rule of law, and voice and accountability.[9]

Considering the other contextual variables, a large body of the literature has examined the positive influence of human capital on economic performance at the country level (Benhabib & Spiegel, 1994; Murphy et al., 1991) and the local one (Moretti, 2004). The availability of well-educated labor forces favors the localization of innovative firms, thus promoting regional productivity. As a proxy for high human capital, we use the percentage of people aged 25–64 with a tertiary education level (ISCED 5–6).

The positive role played by technological capital in promoting productivity has been stressed in the literature following the original contribution by Griliches (1979). Firms may enjoy positive externalities deriving from the local availability of technology, enhancing the local economic performance (Rodríguez-Pose & Crescenzi, 2008; see Audretsch & Feldman, 2004 for a comprehensive survey). Technological capital is proxied by R&D expenditure over gross domestic product.[10]

Social capital is a complex feature of social organization which improves the efficiency of the local society and the transmission of knowledge by increasing the level of trust and thus, in turn, facilitating the cooperation among actors and reducing transaction costs for both firms and consumers (De Blasio & Nuzzo, 2009; Knack & Keefer, 1997; La Porta et al., 1997; Putnam, 1993 for the Italian regions). In this paper, we proxy social capital by the number of people (per 100 inhabitants over 14 years old) that have taken part at least once in the last 12 months in social activities, such as voluntary service (Beugelsdijk & Van Schaik, 2005; Dettori et al., 2012).

Table 5 and Figure 3 show a clear dualistic pattern between Northern and Southern Italy for all the exogenous factors considered. In the case of Institutional Quality, the Southern average is about half of the national one, while the Northern average is 2.4 times higher than the Southern one. As expected, institutional quality is particularly low in territories characterized by the presence of criminal organizations, such as Sicilia (32), Calabria (32), and Campania (42). Six out of the eight Southern regions are in the lowest quartile of the Institutional Quality index distribution, whereas Center-Northern regions display much more variability with none of them in the lowest quartile. Social capital shows a less dramatic difference, but the gap between the South and the North is still remarkable, as the two areas are, on average, 65 percentage points apart. The regional differences are very high, with Trento showing in 2019 the highest value, which is 4.3 times higher than the lowest one in Sicilia. Human capital shows a minor difference between Northern and Southern Italy. At the same time, Central regions have the highest level of graduates with an average value of 19% higher than the national one. Differences between Northern and Southern Italy have decreased over time for social capital and institutional quality, whereas they have increased for human capital (6 percentage points in 2000 vs. 25 percentage points in 2019). Technological capital is similarly distributed as human capital: Central regions display the highest mean value, even if, in this case, it decreases with time (129 in 2000 vs. 110 in 2019). In this case, Southern and Northern Italy show significant and growing differences (32 percentage points in 2000 vs. 45 percentage points in 2019).

It is important to remark that intangible factors exhibit positive correlations,[11] this is particularly the case for the QI and social capital (0.78). We will consider this issue in the econometric estimations.

5 | RESULTS

In this section we present the main results of the empirical analysis. We first discuss the evidence obtained by models in which the capital stock is included as an aggregate or by considering its private and public components. The analysis then proceeds by assessing whether the effects of public capital change

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[9]This index is similar to the Quality of Government Index computed by Gothenburg University for the European regions (Charron et al., 2015).

[10]We cannot use granted patent data since they are usually organized by year of applications and therefore the series is available only until 2012.

[11]The matrix of correlation is reported in Table A4 in the Supporting Information Appendix.

significantly depending on the level of the administrations in charge of managing public investments (central vs. local bodies) or the sector of policy interventions. Finally, we discuss the results of the most general model in which we allow the effect of public capital to change according to both levels of government and intervention sectors. Throughout the analysis we pay particular attention to the role of institutional quality and North–South differences.

5.1 | The basic model

Table 6 reports the main results. In the first specification the capital stock is considered at the most aggregate level. The elasticity of labor is 0.6, while the total capital stock shows an elasticity of 0.38. With respect to previous studies on the Italian case covering the precrisis period (Marrocu & Paci, 2010) the estimated return appears higher for the capital input and lower for the labor input. The QI's variable exhibits the expected positive and significant elasticity. On the contrary, the other intangible assets are not statistically significant; this unexpected result is reasonably due to the high collinearity among the contextual variables. We will return to this issue later. Among the territorial covariates, the population density shows a positive and significant impact signaling the relevance of agglomeration effects, while the dummy South has the expected negative sign, although it is not statistically significant.

In column 2 we include the capital stock according to its two components: private and public capital. They turn out to be both significant with the public stock displaying a higher elasticity (0.36) with respect to the private one (0.23). The public capital elasticity results were three times higher than the one estimated by Marrocu and Paci (2010) for the years 1996–2003. Therefore, it seems that in recent years the role of public institutions in affecting production levels has increased.[12]

Interestingly, the human capital endowment turns out to be significant. The QI maintains its significance and shows a higher elasticity; this is also the case for population density. In this specification, the dummy South has a negative and significant coefficient signaling that, holding all other variables constant, Mezzogiorno's regions are less productive with respect to the rest of the country.

As expected, the social capital coefficient is still not significant due to the high correlation with institutional quality (0.78). To deal with this issue we have considered the single components of the QI index and then we have re-estimated the model in (2) by including only the component that is less correlated (0.42) with social capital: that is, "Government effectiveness."[13] In this case both covariates, government effectiveness and social capital, appears positive and significant although the latter with at a 10% significance level. Moreover, the estimated coefficient of "Government effectiveness" (0.017) is much lower than the one for the composite index (0.096) estimated in the baseline model. To avoid multicollinearity problems, in the subsequent analysis we exclude the social capital variable. Therefore, in (3) we report the estimation results obtained by excluding such variables. For the latter specification, which is the preferred one, in Supporting Information Table A5 we also report a comparison between Ordinary Least Squares and 2SLS estimation; first-stage regressions are presented in Supporting Information Table A6. It is worth noting that the labor elasticity is higher when applying the 2SLS method, whereas the opposite is the case for the private capital one. First-stage F tests are all highly significant confirming the relevance of the instrumental variables.[14]

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[12]We have also computed a more restricted definition of public capital, excluding the transfers to families and firms. Estimation results using the narrower definition of public capital for the baseline model (model 2, Table 6) are very similar. However, the public capital elasticity using the narrow definition (0.29) is lower with respect to the wider one (0.36).

[13]Results not reported to save space but available from the authors upon request.

[14]On model (3) we also performed diagnostic tests to check for possible spatial dependence among the territorial units. Moran's I test result and the results obtained by augmenting the model with the spatial lag of the productive inputs (Spatial Lag of X, SLX model) allowed us to exclude the existence of both global and local spatial dependence, respectively. The spatial analysis was performed by using the first-order contiguity matrix and the inverse distance one. Results are available upon request.

TABLE 6 The effect of public capital on value added, 2000–2019.

Dependent variable: Value added			
	(1)	(2)	(3)
Labor	0.602***	0.463***	0.461***
	(0.090)	(0.069)	(0.065)
Total capital	0.383***		
	(0.094)		
Private capital		0.233***	0.234***
		(0.042)	(0.041)
Public capital		0.362***	0.365***
		(0.049)	(0.045)
Quality of institutions	0.039**	0.096***	0.098***
	(0.018)	(0.018)	(0.019)
Contextual factors			
Human capital	0.054	0.098*	0.096**
	(0.087)	(0.052)	(0.048)
Social capital	0.066	0.005	
	(0.047)	(0.025)	
Technological capital	0.013	−0.023	−0.023
	(0.028)	(0.023)	(0.023)
Population density	0.068**	0.094***	0.094***
	(0.032)	(0.023)	(0.023)
South	−0.060	−0.082***	−0.084***
	(0.049)	(0.032)	(0.027)

Note: Estimation method: Two Stage Least Squares (labor and capital variables are instrumented with their own 5-year lag). All variables are log-transformed. Quality of Institutions and contextual variables are 5-year lagged. South, dummy variable = 1 for the eight Southern regions and 0 for the remaining regions. All models include time dummies and a constant. Robust Standard Errors, in parentheses, are clustered at the region level. Cross-section observations (regions): 21; number of panel observations: 315.

***1%.

**5%.

*10%.

5.2 | Public capital by government bodies

In Table 7 we propose the results for models in which the public capital stock is included according to the institutional level of the administrative bodies in charge of carrying out public investments. We distinguish between *central* bodies (central administration and national public companies) and *local* bodies (regional and local administrations, local public companies). In model (1) of Table 7 we restrict the elasticities of public capital to be the same for the whole country and find that local bodies are slightly more effective (0.079) than central ones (0.060), as in Bom and Ligthart (2014).

TABLE 7 The effect of public capital by government bodies, 2000–2019.

Dependent variable: Value added			
	(1)	**(2)**	**(3)**
Labor	0.620***	0.583***	0.477***
	(0.077)	(0.055)	(0.076)
Private capital	0.092**	0.107***	0.209***
	(0.042)	(0.030)	(0.054)
Public capital			
Central bodies	0.060***	0.060***	0.069***
	(0.019)	(0.017)	(0.013)
Local bodies	0.079***	0.092***	0.084***
	(0.012)	(0.009)	(0.011)
Central bodies * South		0.033*	
		(0.021)	
Local bodies * South		−0.028**	
		(0.015)	
Central bodies * QI lowest quartile			0.018
			(0.013)
Local bodies * QI lowest quartile			−0.018**
			(0.010)
Central bodies * QI highest quartile			−0.045***
			(0.013)
Local bodies * QI highest quartile			0.027***
			(0.009)
Quality of institutions (QI)	0.078***	0.072***	0.052***
	(0.014)	(0.017)	(0.010)
Contextual factors	Yes	Yes	Yes
South	Yes	No	Yes

Note: Estimation method: Two Stage Least Squares (labor and capital variables are instrumented with their own 5-year lag). All variables are log-transformed. Quality of Institutions and contextual variables are 5-year lagged. Contextual factors: human capital, technological capital, and population density. South, dummy variable = 1 for the eight Southern regions and 0 for the remaining regions. All models include time dummies and a constant. Robust Standard Error, in parentheses, are clustered at the region level. Cross-section observations (regions): 21; number of panel observations: 315. See Table 2 for the list of bodies.

***1%.

**5%.

*10%.

In model (2), when we allow the elasticities to vary between the two main macroareas of the country: sizeable and significant differences emerge.[15] Central bodies in the Southern regions exhibit a significantly higher elasticity (0.093) with respect to Center-Northern ones (0.060), whereas the opposite is the case for local bodies. Northern regions exhibit an elasticity (0.092) much higher with respect to Southern ones (0.064).[16] Figure 4a allows for a readily comparison of the estimated elasticities.

Since our models include the QI and several other factors which are expected to account for North–South differences, varying administrative level elasticities could be due to such variables not being adequate to control for latent traits related to institutional quality (Durlauf, 2002), as they are inherently difficult to measure.

As explained in Section 4, low levels of institutional quality are mostly found in Southern regions thus, to gain more insights and enhance our understanding of how the functioning of the institutions may influence the effectiveness of public investment, we propose an alternative specification in model (3). This is obtained by augmenting model (1) with four interactive variables. Both central and local bodies are interacted with two dummy variables capturing low/high levels of institutional quality. More specifically, the first dummy takes the value of 1 when the regional level of institutional quality is in the first quartile of its distribution (low level of institutional quality), whereas the second dummy is equal to 1 for levels of institutional quality in the highest quartile (high levels of institutional quality).

Figure 4b shows the estimated elasticities for public capital considering the different government bodies and institutional quality quartiles. When local bodies are in charge of public investments the effectiveness of public capital significantly increases with the level of institutional quality: The elasticity increases from 0.066 for the lowest levels of QI to 0.084 for the intermediate levels and up to 0.111 for the highest levels. Therefore, the high quality of regional institutions is particularly relevant for the local level of government.

As for central bodies, no significant differences in public capital elasticity (0.069) are detected between the case of regions with low versus intermediate (second and third quartiles) levels of institutional quality. On the contrary, at the highest level of institutional quality, public capital turns out to be less effective (0.024) compared with the intermediate-level case. Although this result is somewhat unexpected and deserves further investigation in future research, it seems to suggest that in regions with the highest levels of QI, local bodies outperform central ones (public capital elasticity almost five times higher, 0.111 vs. 0.024) because they are more capable to leverage the direct knowledge of their territories and stakeholders and to benefit from a general level of trust in delivering their public interventions.

In general, the differences between central and local bodies could be related to the way of functioning of Italian public administrations, rooted in the country's historical development, so strongly influenced by its geography. As argued by Daniele et al. (2018), the process of modern growth that started in Italy in the late XIX century brought about structural changes, differentiated access to markets agglomeration dynamics that set the two macroareas of the country on quite diverging paths, with the Northern one more densely interconnected with the wider and competitive European continental markets resulting in a more open and vibrant socioeconomic environment (see also Felice, 2019). Moreover, national economic policies have favored the Northern regions thus worsening the Italian territorial gap (Viesti, 2021). In recent years this process has been exacerbated by a strong migratory flow of highly qualified young people from the Southern to the Northern regions (Ballarino et al., 2022). This "brain drain" has further impoverished the endowment of human and technological capital in the South. Such a dualistic development process reasonably had important effects also on the administrative practices and ruling approaches of local government bodies in the North and in the South of Italy, although the legislation and the normative setting have been the same across the whole country. Additional arguments have been advanced by Bigoni et al. (2016) which, using a lab-in-the-field experiment, show that the persisting North–South divide can be explained in terms of

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[15]Note that for multicollinearity issues the dummy South is not included in model 2.

[16]Mauro et al. (2023) argue that the decentralization process of the 1970s allocates the provision of public capital to local institutions which, in the Southern Italian regions, are more exposed to a lower social capital and therefore are less effective in supporting the regional economic performance.
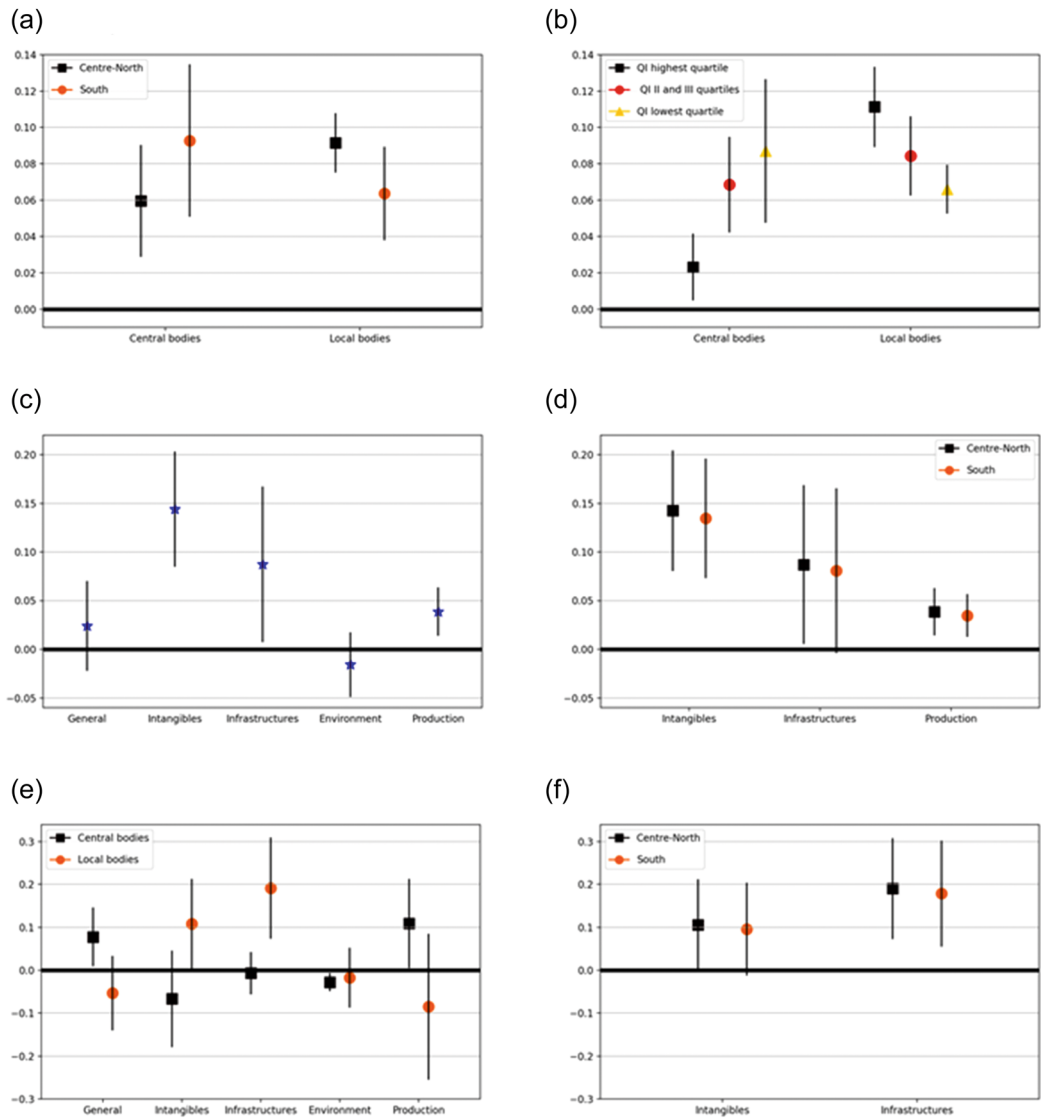
FIGURE 4   Public capital estimated elasticities. (a) By bodies and macroareas (Table 7 model 2), (b) by bodies and quality of institution (Table 7 model 3), (c) by sectors (Table 8 model 1), (d) by sectors and macroareas (Table 8 models 2–4), (e) by sectors and bodies (Table 9 model 1), and (f) for local bodies, by sectors, and macroareas (Table 9 models 2 and 3).

a behavioral gap in cooperation due to differences in preferences, expectations, and social norms.[17] At the same time, it can be argued that such a cooperative gap may be in turn the effect of the lack of development factors in the South (public infrastructures and services, human capital, and innovation) rather than its cause.

No matter what, in the last three decades, Southern territories were incapable of taking advantage of the regional autonomy, enhanced by the 2001 devolution reform of Title V of the Italian constitution. For the Southern regions, the devolution resulted in a more fragmented political environment, higher pressure from specific

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[17]This experiment must be interpreted with caution since it is based on a small sample of 618 participants resident in only average-size cities.

stakeholders, and narrow administrative-decision capabilities to deal with the challenges the Mezzogiorno must confront. These include persistent issues, such as demographic trends, brain drain, low attractiveness for external investment, and the new ones brought about by the pandemic crises and the severe instability of the international scenario. These considerations help in explaining the estimated lower elasticities of Mezzogiorno's public capital once controlling for the positive role of institutional quality.

5.3 | Public capital by macrosectors

Table 8 reports the main results of the analysis carried out to assess the role of public capital according to the macrosectors of policy interventions. Public capital elasticities are also displayed in Figure 4c,d. As discussed in Section 3 (see also Supporting Information Table A2), we distinguish among public investments related to *general* administration, infrastructures in the *intangibles'* assets, *infrastructures*, *environment*, and *production* activities. Model (1) results indicate that the highest elasticity is exhibited by the public capital endowment in the intangibles (0.14), followed by the infrastructures (0.09), and the production sector (0.04). The high heterogeneity of the public expenditures' impact across sectors in the Mezzogiorno has been found by Albanese et al. (2020), who remarked on the positive role of the investment in infrastructures. Similar results have been found by Crescenzi et al. (2016) for the impact of transport infrastructures in the European regions, which turns out to be positively associated with the quality of regional government.

Elasticities for the general and environment macrosectors are not significant. This result might be due to a more indirect role of such kind of public capital on the level of production, but also to multicollinearity issues as the variables are highly correlated. It is worth noting that results for all the other variables included in the model and previously discussed are confirmed. In models 2–4 we test whether the significant elasticities for intangible capital stock, infrastructures, and production macrosectors are the same across the Northern and Southern macroareas of the country. Because of multicollinearity issues, we add the interactive term with respect to the South dummy one at a time while keeping all the variables already included in model 1. All interactive terms are significant and exhibit a negative sign, indicating that macrosectors elasticities are lower for Southern regions. Differences, however, are not sizeable: 0.142 versus 0.134 for intangible capital stock, 0.087 versus 0.081 for infrastructures, and 0.039 versus 0.035 for the production macrosector; in all cases they are higher than 90% of the Northern elasticities.

5.4 | Public capital by bodies and sectors

This section considers whether significant differences in elasticities across sectors could be related to the government level in charge of public investments. Column 1 in Table 9 reports a specification where public capital for each of the five sectors is included separating the central or local body carrying out the expenditure. Interestingly, it emerges that the impact of central and local levels in each sector is highly differentiated (see Figure 4e,f).

As expected, the central government is more effective in general public investment, which comprises the typical centralized activities, like, public order, justice, defense, and health. The impact of public expenditure carried out by the central bodies is positive and significant also in the production sector. This is a predictable result since most of the transfers to the firms, which are a relevant share of public investment in the production sector, are managed by the central bodies. Finally, public capital in the environment sector performed by the central bodies turns out to be negative and significant, which may signal a sort of displacement effect for capital expenditure in other sectors more directly related to VA. Although crucial to enhancing long-run economic performance, the interventions to protect the environment are less likely to produce economic effects at shorter horizons.

TABLE 8 The effect of public capital by economic sectors, 2000–2019.

Dependent variable: Value added				
	(1)	(2)	(3)	(4)
Labor	0.500***	0.506***	0.506***	0.508***
	(0.056)	(0.058)	(0.057)	(0.058)
Private capital	0.226***	0.223***	0.222***	0.220***
	(0.044)	(0.044)	(0.044)	(0.044)
Public capital				
General	0.024	0.034	0.031	0.032
	(0.023)	(0.025)	(0.024)	(0.024)
Intangibles	0.144***	0.142***	0.141***	0.139***
	(0.030)	(0.032)	(0.031)	(0.031)
Infrastructures	0.087**	0.087**	0.087**	0.086**
	(0.041)	(0.043)	(0.042)	(0.042)
Environment	−0.016	−0.018	−0.017	−0.017
	(0.017)	(0.017)	(0.017)	(0.017)
Production	0.039***	0.036***	0.038***	0.039***
	(0.013)	(0.012)	(0.012)	(0.012)
Intangibles * South		−0.008*		
		(0.004)		
Infrastructures * South			−0.006**	
			(0.003)	
Production * South				−0.004**
				(0.002)
Quality of institutions	0.101***	0.098***	0.099***	0.099***
	(0.019)	(0.021)	(0.020)	(0.020)
Contextual factors	Yes	Yes	Yes	Yes
South	Yes	No	No	No

Note: Estimation method: Two Stage Least Squares (labor and capital variables are instrumented with their own 5-year lag). All variables are log-transformed. Quality of Institutions and contextual variables are 5-year lagged. Contextual factors: human capital, technological capital, population density. South, dummy variable = 1 for the eight Southern regions and 0 for the remaining regions. All models include time dummies and a constant. Robust Standard Error, in parentheses, are clustered at region level. Cross-section observations (regions): 21; number of panel observations: 315. See Supporting Information Table TA2 for the list of sectors.
***1%.
**5%.
*10%.

A different picture appears when we look at the sectoral effects of public capital managed by local bodies. In this case the coefficients are not significant for the general, environment, and production sectors. Contrary to what was found for the central levels, local bodies are significantly effective in the provision of public capital related to intangibles (education, culture, and training) and infrastructures sectors. This result has relevant policy implications

TABLE 9 The effect of public capital by bodies and sectors, 2000–2019.

Dependent variable: Value added			
	(1)	(2)	(3)
Labor	0.528***	0.528***	0.575***
	(0.143)	(0.149)	(0.140)
Private capital	0.267***	0.264***	0.236***
	(0.091)	(0.098)	(0.092)
Public capital central			
General	0.078**	0.079**	0.071**
	(0.035)	(0.036)	(0.036)
Intangibles	−0.067	−0.073	−0.057
	(0.057)	(0.058)	(0.057)
Infrastructures	−0.007	−0.002	−0.011
	(0.025)	(0.025)	(0.025)
Environment	−0.028***	−0.028***	−0.027***
	(0.011)	(0.011)	(0.010)
Production	0.109**	0.111**	0.096*
	(0.053)	(0.054)	(0.053)
Public capital local			
General	−0.054	−0.037	−0.051
	(0.044)	(0.041)	(0.040)
Intangibles	0.108**	0.106**	0.097*
	(0.054)	(0.054)	(0.052)
Infrastructures	0.191***	0.188***	0.191***
	(0.060)	(0.062)	(0.060)
Environment	−0.017	−0.019	−0.024
	(0.036)	(0.038)	(0.035)
Production	−0.085	−0.087	−0.070
	(0.087)	(0.090)	(0.086)
Intangibles * South		−0.010**	
		(0.005)	
Infrastructures * South			−0.012***
			(0.004)
Quality of institutions	0.092***	0.090***	0.079***
	(0.021)	(0.023)	(0.021)

(Continues)

TABLE 9 (Continued)

Dependent variable: Value added			
	(1)	**(2)**	**(3)**
Contextual factors	Yes	Yes	Yes
South	Yes	No	No

Note: Estimation method: Two Stage Least Squares (labor and capital variables are instrumented with their own 5-year lag). All variables are log-transformed. Quality of Institutions and contextual variables are 5-year lagged. Contextual factors: human capital, technological capital, population density. South, dummy variable = 1 for the eight Southern regions and 0 for the remaining regions. All models include time dummies and a constant. Robust Standard Error, in parentheses, is clustered at the region level. Cross-section observations (regions): 21; number of panel observations: 315. See Table 2 for the list of bodies and Supporting Information Table TA2 for the list of sectors.
***1%.
**5%.
*10%.

because the increase in the endowment of capital in such sectors is crucial for driving regional performance along sustainable, innovative, high-value growth trajectories.

To investigate more on these positive impacts, we allow for the public capital coefficient in intangibles (column 2) and infrastructures (column 3) managed by local bodies to be different across macroareas of the country. For both sectors, the public capital managed by the Mezzogiorno local administrations exerts an impact that is lower than the Center-North one.

These results generally highlight that local and central bodies have a specialized objective that appears highly differentiated across sectors. Their heterogeneous sectoral impact on the regional production levels calls for great attention in the definition of both general and place-based policy measures and in the allocation of financial resources.

6 | CONCLUSIONS

This study has analyzed how the public capital stock and the institutions' quality influence regional economic performance. Such analyses are crucial to advance our understanding on the effectiveness of European and national economic growth policies and to assess the ability of the local institutions in Italy to efficiently invest the vast NRRP resources they are about to receive to boost the economy after the pandemic crisis.

The regional series of public capital stock - and their disaggregation into different macrosectors or according to various government levels managing the funds—have been reconstructed using the data on investment expenditures of the Extended Public Sector made available through the CPT database. Our novel database comprises all investment expenditures by national and local administrations and public companies. Therefore, it includes the capital expenditures financed by the EU structural funds, whose effects are thus implicitly considered in our analysis. We estimate Cobb–Douglas production functions relationships, including the standard production inputs such as labor units, private and public capital stock, together with the institutions' quality, intangible assets, and territorial features. Production functions have been estimated using the 2SLS methodology to deal with endogeneity issues. Given the use of lagged variables as instruments, our results must be interpreted cautiously. Notwithstanding this limitation, we think that our study provides novel evidence on public intervention and contributes to the current debate on the determinants of regional growth.

The first result is that public capital stock plays a positive role in driving the level of production, with a higher elasticity with respect to the private one. A second important finding is the role played by the QI; a variable often

neglected in previous studies on production function estimation because of a lack of reliable data. The positive and significant elasticity exhibited in all specifications remarks the importance of public institutions for fostering the development processes and enhancing economic growth. In this regard, more research is needed to disentangle the complex mechanisms through which local institutions influence, directly and indirectly, the regions' economic performance (Rodrìguez-Pose, 2020).

The disaggregation of public capital into macrosectors has shown a high degree of heterogeneity in its impact on production levels. A crucial role is exerted by the intangibles, remarking the productivity-enhancing effect of capital accumulation in culture, human capital, training, and research. Positive and significant elasticities have also been estimated for the infrastructures, like, transports and telecommunications. A positive effect is found for the public capital directly devoted to the production sectors, including capital transfers to private companies to support their investments.

A central result of our analysis is the considerable difference across territorial areas and sectors in the impact of capital expenditure realized by central and local institutions. Considering the disaggregation into government levels, it turns out that in Southern Italy, central bodies display a higher elasticity than the Center-North. The opposite result is found for the local bodies, which prove much less effective in the Southern regions. Our analysis provided sound evidence that the effectiveness of public capital managed by local bodies significantly increasing with the level of institutional quality, which have been persistently low in the Mezzogiorno of the country.

This might be rooted in the country's historical development strongly influenced by its geography.[18] Moreover, the macroeconomic factors and the economic policy choices of the national governments contributed to worsen the North–South gap triggering a vicious circle. The Southern regions have been characterized by less development, less provision of public services and infrastructures, less employment opportunities, brain drain, further reduction of human capital and innovation. The combination of these deep-root factors with current economic dynamics could also have shaped the different ways of public administrations functioning across macroareas of the country. The low elasticity estimated for the public capital stock realized by Southern local administrations cast shadows on the success of NRRP and other cohesion policies. More than 120 billion euros should be invested by the local institutions in the Southern regions respecting the EU rigorous rules in the next years. The inefficiency and inadequacies that characterized Southern local administrations might determine the policy's failure, losing a unique opportunity to narrow the economic gap between North and South of Italy.

To avoid these negative consequences, it is necessary to act urgently at least in two directions. In the short run, since the programs must be in place immediately and the expenditures completed in a few years, the central government must help the local administrations by making available in each Southern region a task force of experts to follow the implementation phases of the programs.

At the same time, it is imperative to adopt, urgently, long-run policies to address the profound and structural issues related to the low institutional quality of the Southern regions in Italy. As our results have shown, Mezzogiorno's low QI is one of the most relevant factors that continue to slow down its development. As we have previously discussed, the causes of such negative features are numerous, complex, intertwined, and deep-rooted in the historical and economic development of the South. Therefore, improving the quality of the local institutions is not an easy task, as demonstrated by decades of failures of the North–South territorial rebalancing policies in Italy.[19] If local institutions' quality is rooted in the country's historical development and in decades of vicious economic twist, it cannot be simply changed or improved by a central government law. What is needed is a

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[18]According to d'Adda and de Blasio (2017) the lower effectiveness of development-enhancing policies directly implemented by local administrations in the Southern Italy territories depends on their historical legacy: that is, having been part of the Kingdom of the Two Sicilies characterized by a high degree of autocracy.

[19]A rapid improvement in the institutional quality can be also determined in the short run in the presence of extraordinary external shocks, like, the fall of communism and the entrance into the EU for the Central and Eastern European countries (Rodrìguez-Pose, 2020, p. 375). The persistence of a low-quality institutional level in the Mezzogiorno regions is clearly different since they have been part of a common national institutional setting over the last 150 years.

profound change in the Southern regions in people's social norms and individual behaviors, which can be attained, in our opinion, only through a long-term education policy. Investing, for a long period of time, considerable human and financial resources in the schooling and university system in the Southern regions seems the only policy able to break the persistent territorial divide in Italy and activate a virtuous and self-reinforcing mechanism by which increasing levels of human capital create a more favorable local environment for families and firms and contribute to further enhance the QI.

Finally, it is worth noting that our results also have external validity. Several European regions, or even countries, share with the Italian Mezzogiorno similar structural gaps—in terms of human capital, QI, innovative capacity, and per capita income—and have to confront the challenge of effectively managing the EU next-generation funds to recover from the pandemic crisis and to counterbalance the international scenario instability.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in Conti Pubblici Territoriali at https://www.agenziacoesione.gov.it. These data were derived from the following resources available in the public domain: Conti Pubblici Territoriali, https://www.agenziacoesione.gov.it.

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Additional supporting information can be found online in the Supporting Information section at the end of this article.