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KEYWORDS

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This contribution introduces a series of gap indicators—Waste Management Gap Indicator (WMGI), Local Transport and Roads Gap Indicator (TRGI), and Cultural Services Gap Indicator (CSGI)—to systematically measure discrepancies between actual and standard capital expenditures. These indicators are visualized through cartograms that highlight geographical disparities and track improvements over the study period. The findings reveal significant regional disparities, particularly between northern and southern municipalities, and underscore the urgent need for targeted investments to bridge these gaps and enhance local resilience and attractiveness. The paper concludes with policy recommendations to optimise infrastructure investments to support sustainable local development across Italy.

Modelling Infrastructure Gaps in Italian Municipalities

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January 7, 2025

Abstract

This study develops an empirical framework to assess Local Expenditure Needs (LENs) for infrastructure across Italian municipalities from 2016 to 2022, focusing on local transport, waste management, and cultural services. Utilizing a comprehensive dataset from the Banca Dati delle Amministrazioni Pubbliche (BDAP), which includes over 1,000 variables, the study presents a robust method to quantify the existing gaps in infrastructure investment. The innovative approach leverages capital expenditure data, moving beyond traditional methodologies primarily focusing on current expenditure evaluations. This contribution introduces a series of gap indicators—Waste Management Gap Indicator (WMGI), Local Transport and Roads Gap Indicator (TRGI), and Cultural Services Gap Indicator (CSGI)—to systematically measure discrepancies between actual and standard capital expenditures. These indicators are visualized through cartograms that highlight geographical disparities and track improvements over the study period. The findings reveal significant regional disparities, particularly between northern and southern municipalities, and underscore the urgent need for targeted investments to bridge these gaps and enhance local resilience and attractiveness. The paper concludes with policy recommendations to optimise infrastructure investments to support sustainable local development across Italy.

Keywords: Infrastructure gap; Municipal investment; Capital expenditure; Fiscal federalism; Italian municipalities.
JEL codes: H54, H72, R11, R58

1. Introduction

Focusing on the period from 2016 to 2022, leveraging data from the Banca Dati delle Amministrazioni Pubbliche (BDAP), we constructed a granular dataset comprising over 1,000 variables to assess municipal expenditures and infrastructural characteristics of Italian municipalities. Our study develops and applies a series of gap indicators to measure the discrepancies between actual and standard capital expenditures across various sectors, including waste management, local transport, roads, and cultural services.

The aim of the analysis is to propose a quantitative procedure concerning two objectives: i) the construction of an original dataset including structural and financial information, and ii) the evaluation of the gap between the actual capital expenditure and the infrastructure needs.

We introduce a methodological framework that utilizes advanced data fusion and integration techniques, providing a robust basis for longitudinal analysis. Key indicators, such as the Waste Management Gap Indicator (WMGI), Local Transport and Roads Gap Indicator (TRGI), and Cultural Services Gap Indicator (CSGI), highlight the infrastructural gaps at the municipal level. These indicators are illustrated through cartograms that illustrate geographical disparities and improvements over time.

Our analysis includes all Italian municipalities. We examine municipal data such as capital transfers, expenditure rigidity, and loan repayment expenditures, highlighting municipalities' fiscal constraints and capabilities. Our data show that municipalities account for 20% of total public investments, with total capital expenditure exceeding €15 billion in 2022, marking a 36% increase since 2016. However, there are stark differences in expenditure capacity between northern and southern municipalities, with the latter facing significant challenges in implementing investments.

Our findings reveal significant regional disparities in infrastructure endowment and service delivery, underscoring the critical need for targeted investments to enhance local resilience and attractiveness. The study also proposes the Total Services Gap Indicator (TSGI) to evaluate the overall infrastructural gap, integrating data on population, municipal area, and urbanization levels.

The rest of the paper is organized as follows: section 2 presents a critique literature review of the existing methodologies related to the estimation of standard capital expenditure requirements at local level, section 3 illustrates the data used in our analysis, section 4 details the empirical methodology and gap indicators developed for this study, and section 5 discusses the results,

highlighting regional disparities and the effectiveness of current investment strategies. Finally, section 6 concludes with policy recommendations aimed at improving infrastructure investment and management across Italian municipalities.

2. Literature review

This research contributes to the literature on fiscal federalism by providing empirical insights into the capital LENs of Italian municipalities. It offers a quantitative procedure for assessing infrastructure gaps, which is essential for designing efficient equalization transfers and strategic planning.

Estimating standard requirements is a first necessary step towards building an efficient and mechanism for the distribution of equalization transfers. In literature (see Dafflon and Mischler, 2007 for a complete survey) several allocation techniques have been proposed in recent years which differ for their complexity and the informative setting size they needed. The most used methods, namely those based on the cost function - in the full or reduced form - focus, however, on Local Authorities current expenditure part and do not propose any solution for the capital part (Herrero-Alcalde et al., 2010; Porcelli 2015).

Among the few methodological published contributions (see Levtchenkova and Petchey, 2007, Petchey et al., 2000, Sharma and Bhanumurthy, 2011) it's hard to find a basic theoretical model that can be used as a reference for the Italian infrastructure local expenditure needs. Notwithstanding the absence of benchmark model, however, in the literature, an important common thread can be found: the need to evaluate the existing capital stock both in physical and monetary terms; this twofold requirement represents an important dissimilarity factor with respect to the methodological paths usually follow for the standardization of current expenditure.

In the literature, there are two main approaches to measuring infrastructural endowment (public capital): estimating it in physical terms or in monetary terms by means of Perpetual Inventory Method, suggested by Goldsmith (1951) and now used by most national statistics institutes (a critical survey of both applications is in Mazziotta, 2005). The monetary measurement of public capital certainly has advantages (great uniformity and flexibility, properties of additivity, etc.). Nevertheless, regional disparities in infrastructural transport endowment can probably be better grasped by estimates expressed in physical terms. This is above all because sometimes radically diverse topography (chiefly, mountainous terrain in some places) means that equal investment in money amounts is not equivalent.

The two mentioned approaches are usually alternatives; however, in our analysis, we will concentrate on the monetary evaluation, specifying a representative expenditure system model for capital expenditure which relates historical capital expenditures to local context characteristics. We will then use the fitted values of the model to obtain an estimate of capital

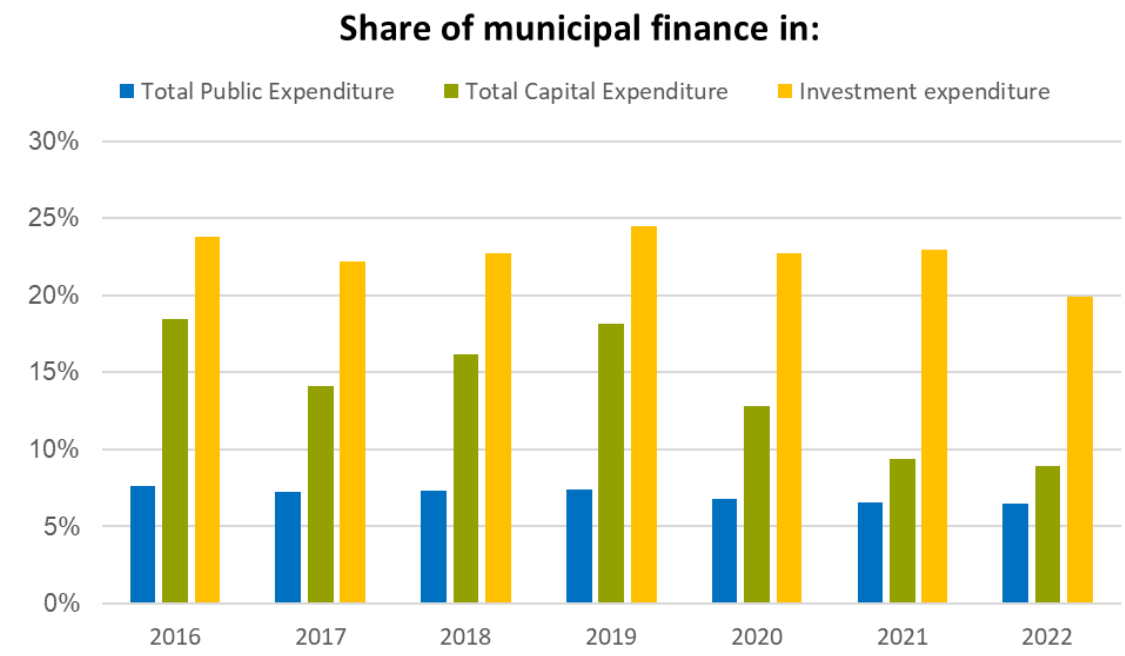
expenditure needs in order to estimate the infrastructural gap in monetary terms as the difference between standard and historical expenditures when the former is larger than the latter.

3. Empirical analysis

3.1Data

The assessment of the Italian infrastructural gap relies on the measurement of actual capital expenditure, providing a direct evaluation of ongoing and completed investments.
Since local governments manage 20% of public investment, municipalities play a central role in determining Italy's infrastructural landscape. The Banca Dati delle Amministrazioni Pubbliche (BDAP) serves as the primary source of detailed municipal financial data. This database provides comprehensive information on both current and capital expenditure, broken down by service categories such as "missioni" and "programmi," and includes both accrual and cash values. The panel structure of this data spans from 2016 to 2022, covering all 7,901 Italian municipalities and incorporating over 1,000 variables.
Data for the computation of the indicators are primarily sourced from the “Banca Dati delle Amministrazioni Pubbliche (BDAP)”, focusing on accrual-based capital expenditures by service. The period of analysis spans from 2016 to 2022, encompassing all Italian municipalities (7,901 local authorities) and integrating expenditures with contextual variables such as population, municipal area, and urbanization level. This comprehensive approach allows for a robust evaluation of infrastructural needs across Italy, where municipalities account for 20% of total public investments.

Figure 1- Share of municipal finance



Source: General government statistics (annual account)

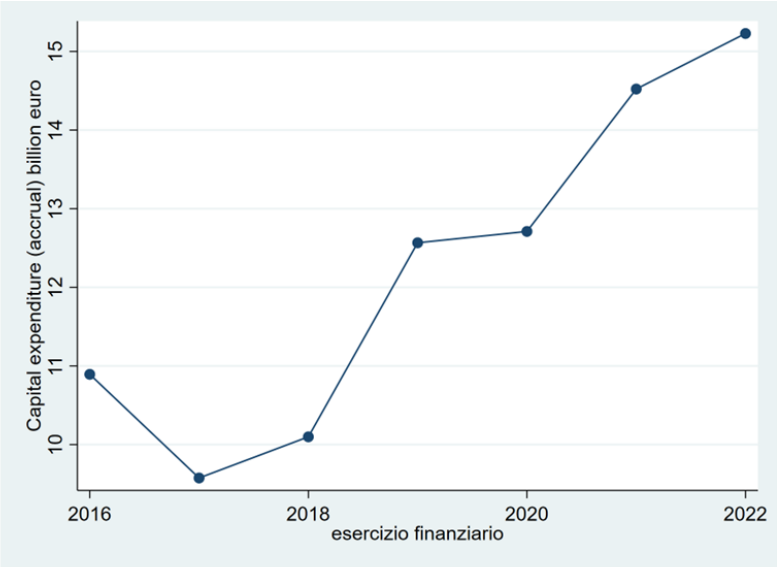
The measurement of actual capital expenditure is a critical factor in evaluating infrastructural gaps and future needs across municipalities. This data provides valuable insight into the allocation and execution of public investments. Municipalities are pivotal actors in Italy's public investment framework, playing a crucial role in addressing local infrastructural needs and contributing to the nation's overall economic development. Although municipalities manage only 7% of total public expenditure, they are responsible for 9% of the total capital expenditure, demonstrating their significant influence in areas requiring long-term investment and development.

As shown in Figure 1, In terms of public investments, municipalities oversee 20% of the total, highlighting their central position in executing projects aimed at improving local infrastructure, services, and economic growth. These investments are essential not only for urban centers but also for more remote areas, where they address specific needs in mobility, public services, and other sectors critical for local development.

The ability of municipalities to manage and execute these investments directly impacts regional development patterns, influencing disparities between urban and rural or inland areas. Their allocation of resources, particularly in sectors such as transportation and public services, directly shapes the quality of life and economic opportunities within their jurisdictions.

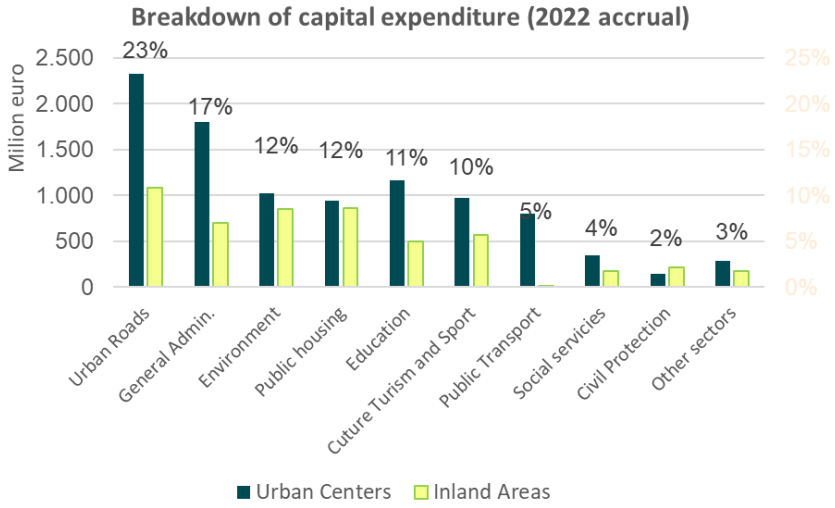
As shown in Figure 2, Italian municipalities have seen a notable rise in capital expenditures over recent years, reflecting their increasing role in driving local infrastructure development and public investment. In 2022, the total capital expenditure by municipalities surpassed 15 billion euros, marking a significant contribution to public investments. From 2017 onwards, there has been a clear upward trend in municipal capital spending, with a real-term increase of 36% since 2016, mainly as a result of the introduction of new fiscal rules. This growth underscores the expanding scope of municipal involvement in critical infrastructure projects, such as transportation, public services, and urban development, which are crucial to regional development and addressing infrastructural gaps across the country. This rising trend demonstrates municipalities' growing capacity to manage and execute substantial investments, reinforcing their role in shaping Italy's economic landscape at the local level.

Figure 2 – Trend in municipal capital expenditure



Source: Authors' elaboration on BDAP database (real values, 2022 base year)

Figure 3 – Structure of municipal capital expenditure



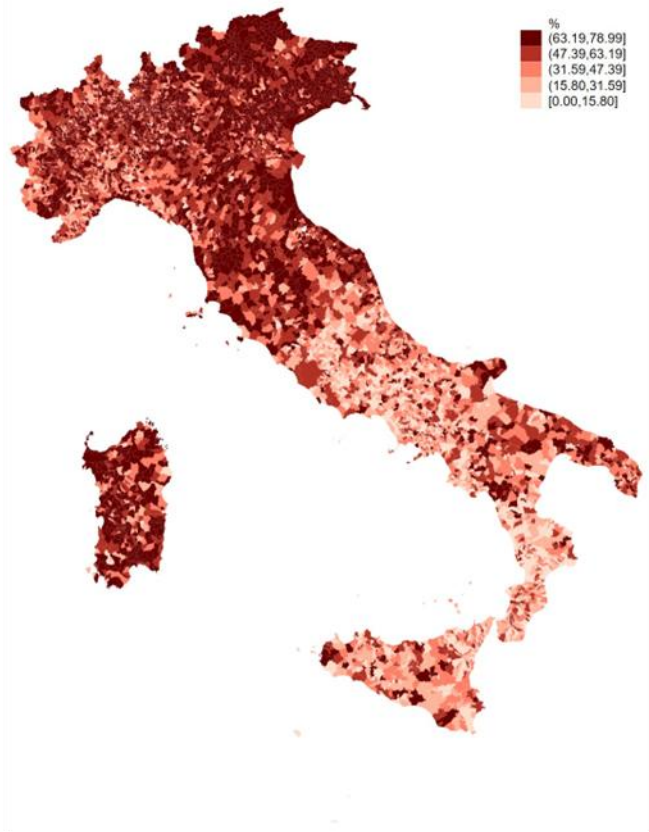
Source: Authors' elaboration on BDAP database

As shown in Figure 3, in 2022, Italian municipalities allocated a significant portion of their capital expenditures toward enhancing mobility, a critical sector for both urban and rural development. 23% of total municipal capital expenditures were directed toward urban roads, while 5% went to public transportation. These investments reflect the focus on improving transportation infrastructure, which is vital for connectivity, economic activity, and quality of life in both densely populated and remote areas. However, urban centres and rural or inland areas display differing patterns in how these funds are utilized. While urban regions generally benefit from more efficient investment, the southern and rural areas of Italy face persistent challenges in implementing

infrastructural projects. These disparities underscore the difficulties in addressing the needs of more isolated or economically disadvantaged regions. Urban centres tend to focus more on projects aimed at modernizing transportation networks, improving public transit systems, and addressing the needs of a growing population. In contrast, inland and rural areas often face challenges in implementing such investments due to geographical, economic, or logistical constraints, leading to slower progress in infrastructure development. This divergence in spending patterns highlights the differing needs and priorities of municipalities across Italy, as well as the ongoing effort to address infrastructural imbalances between urban and rural regions.

The capital expenditure capacity of municipalities, defined as the ratio between cash and accrual values, provides key insights into the efficiency of investment implementation across regions. At the national level, the average expenditure capacity stands at 55%, indicating that just over half of the planned investments are executed in cash terms relative to their accrual commitments.

Figure 4 – Geographical distribution of Capital Expenditure Capacity



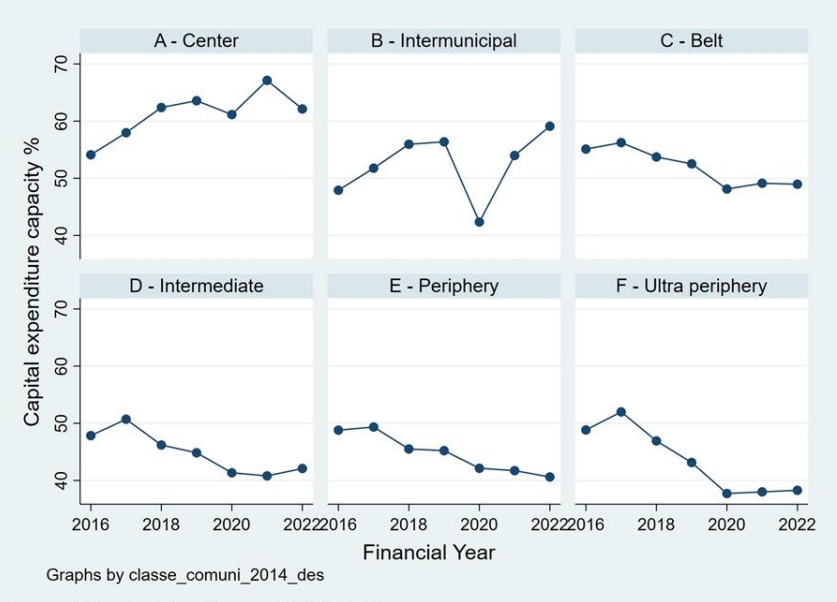
Source: Authors' elaboration on BDAP database (year 2022)

However, as shown in Figure 4, there is a notable divide between northern and southern municipalities. Northern municipalities tend to outperform the national average, demonstrating a higher capacity to execute planned investments efficiently. In contrast, southern municipalities

typically fall below the national average, reflecting greater challenges in translating planned investments into tangible projects. Despite these difficulties, certain regions in the South, such as Sardegna, Puglia, and Basilicata, serve as exceptions. These regions have managed to overcome some of the common barriers to investment and exhibit relatively higher capital expenditure capacities compared to their southern counterparts. Nonetheless, the broader trend indicates persistent challenges in implementing investments in the South, which can hinder efforts to address regional disparities in infrastructure development.

As reported in Figure 5, when analysing the capital expenditure capacity (cash/accrual values) across urban and rural areas, a clear contrast emerges in the ability to implement planned investments. In urban areas, the expenditure capacity is generally above 50% and has been increasing over time. This indicates that municipalities in urban centres are progressively becoming more efficient in executing their investment plans, reflecting better infrastructure, financial management, and project execution capabilities.
Conversely, in rural areas, the expenditure capacity tends to fall below 50% and has been decreasing over time. This suggests increasing difficulties in implementing planned investments in these regions, where logistical, financial, and administrative barriers may impede the effective execution of projects.
These trends underscore the challenges rural areas face in infrastructure development, leading to a growing disparity between urban and rural regions in terms of capital investment capacity. The lower efficiency in rural areas further exacerbates existing infrastructural gaps, limiting growth and development in the periphery compared to more dynamic urban centers.

Figure 5 – Distribution of Capital expenditure Capacity between central and peripherical municipalities



Source: Authors' elaboration on BDAP database

3.2 Methodology

According to fiscal federalism principles, implementing efficient infrastructural equalization, provides that a comparison of the infrastructure service levels with the corresponding service standards should be implemented using appropriate indicators to measure any deviations. The literature provides several contributes about current expenditure connected to local services, but it is hard to find significant proposals for public capital expenditure estimation. The research package will aim to propose a quantitative procedure concerning two objectives: i) the evaluation of the gap between the effective infrastructural endowment and the infrastructure needs deduced from the factors of demand generation; ii) the conversion in monetary terms of this gap.

Estimating standard requirements is a first necessary step to design an efficient mechanism for the distribution of equalization transfers. The literature (see Dafflon and Mischler, 2007) provides several allocation techniques with different degrees of complexity and informative setting size. The most used methods, namely those based on the cost function - in the full or reduced form - focus, however, on Local Authorities' current expenditure and do not propose any solution for capital expenditure (Herrero-Alcalde et al., 2010; Porcelli, 2015). Among the few methodological articles (see Levtchenkova and Petchey et al., 2000, Sharma and Bhanumurthy, 2011), it's hard to find a basic theoretical model that can be used as a benchmark for the Italian local expenditure needs in infrastructure. However, an important common characteristic can be found in the theoretical literature: the need to evaluate the existing capital stock in physical and/or monetary terms (Goldsmith, 1951; Mazziotta, 2005).

The objective of our analysis is to propose an empirical framework to evaluate the local expenditure needs in infrastructure, considering the supply and demand factors measuring the existing infrastructural gap. The focus will be on the local transport, culture and environmental (waste management) infrastructure for the Italian territories (municipalities, provinces, metropolitan districts and regions) where municipal expenditure covers almost all the public investments in those public functions.

Regional disparities in infrastructural transport, culture, and waste management endowment could be better grasped by estimates expressed in physical terms. Indeed, sometimes radically diverse topography means that equal investment in money amounts is not equivalent in physical unity across the regions. However, the monetary measurement of public capital certainly has advantages in terms of great uniformity and flexibility, properties of additivity, etc. The estimated monetary differences between expenditure and physical endowment allows us to obtain the representative estimated price/cost of the considered infrastructure.

The Infrastructure Gap Indicator (GAP) measures the per capita monetary difference between actual and standard capital expenditures in a due sector (waste management, local transport, etc.) or more sectors (sum of expenditures in different sectors) at the municipal level. The standard is defined as the national average capital expenditure from 2016 to 2022, weighted by the following variables:

Resident population,

Municipal area in square kilometres,

Classification of municipalities into six urbanization clusters: Center, Intermunicipal, Belt, Intermediate, Periphery, and Ultra-periphery.

The evaluation of the Capital Expenditure Gap for the year 2022, for each municipality i, corresponds to the following formula in equation (1):

$$\mathrm{GAP}_i^{2022} = \frac{SEXP_i - HEXP_i^{2022}}{Pop_i^{2022}}, \quad if\ SEXP_i > HEXP_i^{2022}$$

Where:

- i indicates the municipality index;
- $HEXP_i^{2022}$ corresponds to the historical capital expenditure allocated to the waste management service in 2022;
- Pop_i^{2022} corresponds to the resident population of the municipality in the year 2022;
- $SEXP_i$ corresponds to the standard capital expenditure computed as the average capital expenditure at the national level between 2016 and 2022 conditional on the population of the municipality, the surface of the municipality in Km sq. and, finally, to the classification of the municipalities into six urbanization clusters (Center, Intermunicipal, Belt, Intermediate, Periphery, and Ultra-periphery).

In particular, $SEXP_i$ is obtained from the fitted values of the following regression model and reported in equation (2), estimated using Ordiary Least Squares (OLS) with robust standard errors:

$$HEXP_{it} = \beta_0 + \sum_b \beta_b Pop_dummy_{it}^b + \beta_2\, Kmsq_i + \sum_r \gamma_r Rural_dummy_{it}^r + \varepsilon_{it} \qquad (2)$$

Where:

- i indicates the municipality index;
- t indicates the year indicator since we employ a panel of seven years for the analysis;
- $Pop_dummy_{it}^b$ corresponds to the resident population brackets to which of the municipality belongs to;

- $Kmsq_i$ corresponds to the surface in km sq. of the municipality;
- $Rural_dummy_{it}^{r}$ corresponds to the specific classification of the municipalities among the six categories of the rural vs urban area;
- β_0 is the constant of the model;
- β_b are the coefficients associated with the population brackets;
- γ_r are the coefficients associated with the rural vs urban categories;
- ε_{it} is the idiosyncratic error of the model.

We apply this methodology to three expenditure categories which have particular importance in the modern systems of decentralized finance: waste management, local transport, and cultural services.

Municipal waste management expenditure has a significant impact on environmental sustainability. Proper waste management practices are essential for reducing the environmental footprint of communities and promoting a healthier planet. When municipalities invest in waste management infrastructure and programs, they can effectively mitigate the negative effects of waste on the environment.

Municipal waste management expenditure plays a critical role in promoting environmental sustainability. Investments in infrastructure, recycling programs, and effective policies can lead to significant environmental benefits, including reduced pollution, resource conservation, and lower greenhouse gas emissions. However, the success of these expenditures hinges on equitable funding distribution, efficient management, and strong policy frameworks. As municipalities continue to grapple with waste management challenges, it is essential to prioritize sustainable practices and ensure that expenditure translates into tangible environmental benefits.

Effective **local transport** systems are vital for economic development. They facilitate the movement of goods and people, reducing travel time and costs associated with commuting. Improved transport connectivity attracts businesses, boosts local economies, and creates job opportunities. For instance, cities with well-developed public transport networks, such as New York and Tokyo, experience robust economic activity and higher employment rates. Public transit systems also enhance property values, as areas with good accessibility become more desirable for residential and commercial investments.

Local transport systems play a crucial role in promoting social inclusion and accessibility. Reliable and affordable public transport ensures that all individuals, including those from low-income backgrounds and people with disabilities, have access to essential services such as healthcare, education, and employment. In cities like Copenhagen, the extensive bike-sharing programs and pedestrian-friendly infrastructure exemplify how thoughtful transport planning can enhance accessibility and inclusivity. Improved transport systems reduce social isolation and enable greater participation in community activities, fostering a more cohesive society.

Local culture expenditure significantly contributes to the economic vitality of municipalities. Funding cultural events, museums, theatres, and other cultural institutions stimulates the local economy by attracting tourists, generating revenue, and creating jobs. For instance, cities like Edinburgh, known for its renowned festivals, benefit economically from cultural tourism, which supports local businesses and increases tax revenues. Additionally, cultural investments can lead to the regeneration of urban areas, turning neglected neighbourhoods into vibrant cultural districts, thereby attracting further private investment and boosting property values.
The cultural life in a municipality is closely linked to the quality of life too. Cultural amenities such as theatres, galleries, music venues, and public art installations enrich residents' lives, providing leisure and educational opportunities. Cities like Paris and Vienna, renowned for their rich cultural offerings, consistently rank high in quality-of-life indices, attracting new residents and businesses. Furthermore, cultural vibrancy makes cities more attractive to skilled professionals and creative industries, fostering an innovative and dynamic urban environment. This, in turn, can lead to a virtuous cycle where increased attractiveness attracts more cultural investments, further enhancing the city's appeal.

In general, local capital expenditure refers to the funds allocated by municipalities towards the development and maintenance of long-term assets, such as infrastructure, public facilities, and technological systems. These investments are critical for enhancing local resilience, which is the ability of a community to withstand, adapt to, and recover from adverse situations such as economic downturns and social challenges. This essay explores how local capital expenditure influences local resilience, focusing on infrastructure, public services, and technological advancement.
Despite the clear benefits, there are challenges associated with capital expenditure. Ensuring equitable distribution of funds and prioritizing projects that offer the most significant resilience benefits can be difficult. Additionally, long-term planning and sustained investment are required to realize the full potential of capital projects, which can be challenging in the face of budget constraints and political changes. Municipalities must also balance immediate needs with future risks, ensuring that capital expenditure addresses both current vulnerabilities and anticipated challenges.

3.3 Results

The Waste Management Gap Indicator (WMGI) measures the per capita monetary difference between actual and standard capital expenditures in waste management at the municipal level. The standard is defined as the national average capital expenditure from 2016 to 2022. The indicator is depicted in three panels on a cartogram in Figure 6.

Similarly, the Local Transport and Roads Gap Indicator (LTRGI) measures the per capita monetary difference between actual and standard capital expenditures in local transport and road maintenance at the municipal level. This standard is also defined as the national average capital expenditure from 2016 to 2022. The indicator is depicted in three panels on a cartogram in Figure 7.

Using the same graphical analysis, Figure 8 reports the Cultural Services Gap Indicator (CSGI), which measures the per capita monetary difference between actual and standard capital expenditures in cultural services at the municipal level. This standard is defined as the national average capital expenditure from 2016 to 2022.

Finally, Figure 9 displays the Total Services Gap Indicator (TSGI), which measures the per capita monetary difference between total actual and standard capital expenditures at the municipal level. This standard is defined as the national average capital expenditure from 2016 to 2022.

In all figures from 6 to 9, the left panel shows the geographical distribution of the standard capital expenditure per capita, reflecting the infrastructural needs. The middle panel displays the infrastructural gap, defined as the difference between the standard and the actual capital expenditures in 2022, when the standard is higher than the actual expenditure. The right panel highlights municipalities that reported a gap smaller than in 2016 in real terms in 2022, indicating some progress in bridging the gap.

Each indicator provides an estimate of the infrastructural gap in monetary terms for the respective sector at the municipal level as measured in 2022, considering changes from 2016 to 2022."

Figure 6: Waste management capital expenditure gap, euro per capita

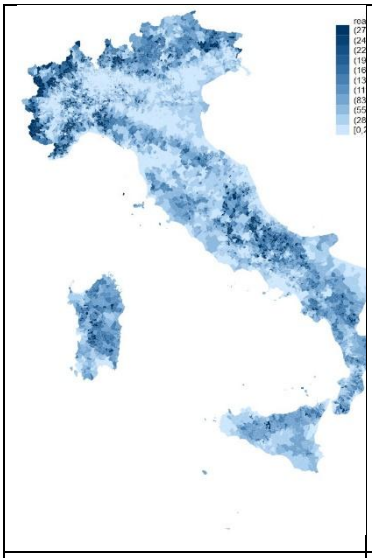
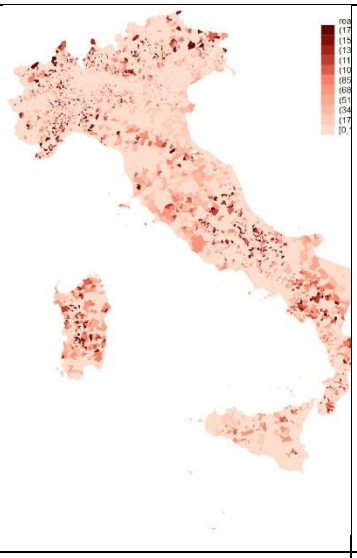
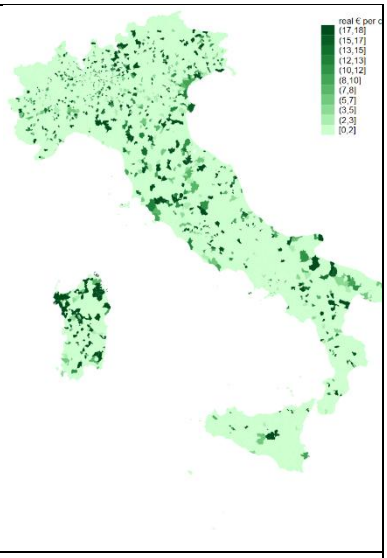
		
WSEXP **Waste management Standard Capital Expenditure (average over 2016-2022)** **(a)**	**WGAP** **Waste management Capital expenditure Gap 2022 = (Standard capital expenditure – Historical Capital expenditure 2022, if Standard > Historical)** **(b)**	**WGAP2022 – WGAP2016** **Waste management Gap improvement (Gap 2022 – Gap 2016. if Gap 2022 < Gap 2016)** **(c)**

Figure 7: Local Transport and Roads capital expenditure gap, euro per capita

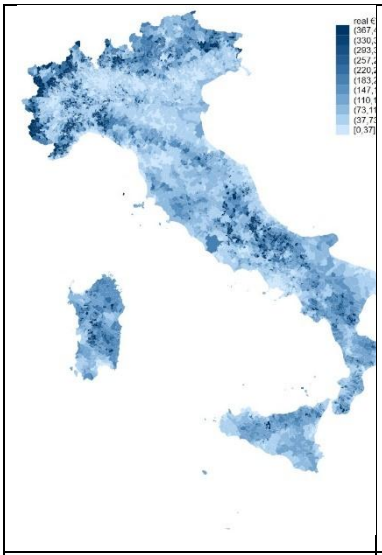
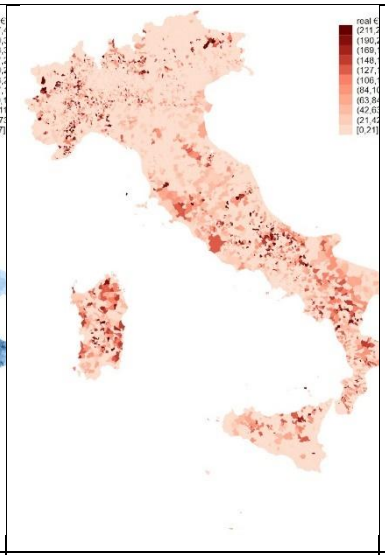
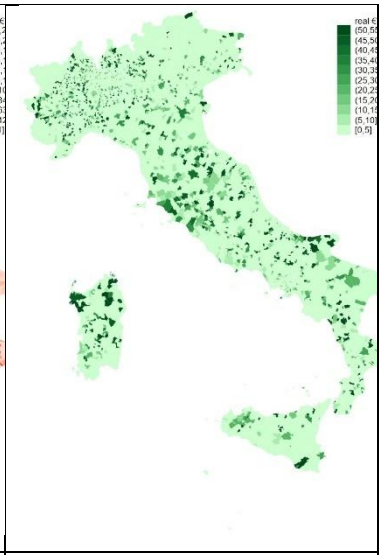
		
LSEXP **Local Transport and Roads Standard Capital Expenditure (average over 2016-2022)** **(a)**	**LGAP** **Local Transport and Roads Capital expenditure Gap 2022 = (Standard capital expenditure – Historical Capital expenditure 2022, if Standard > Historical)** **(b)**	**LGAP2022 – LGAP2016** **Local Transport and Roads Gap improvement (Gap 2022 – Gap 2016. if Gap 2022 < Gap 2016)** **(c)**

Figure 8: Cultural services capital expenditure gap, euro per capita

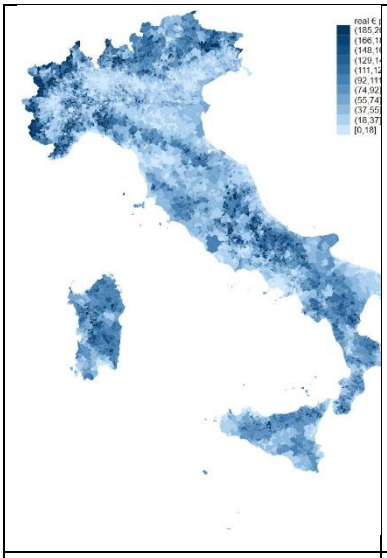
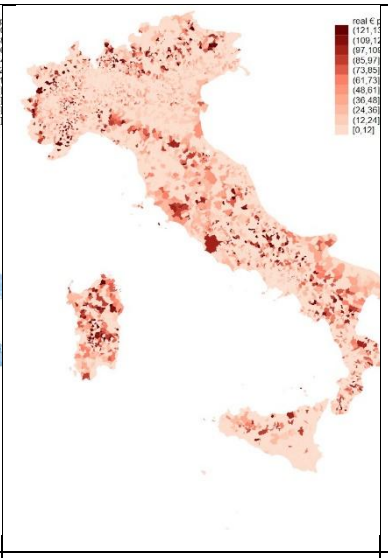
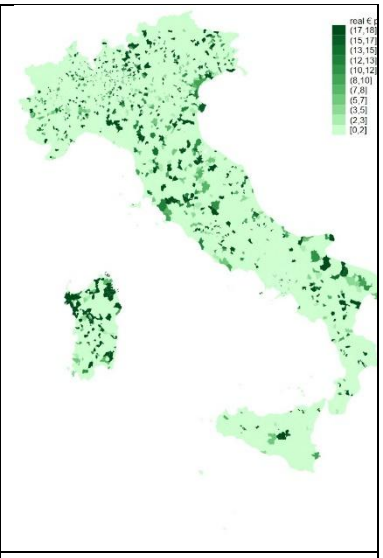
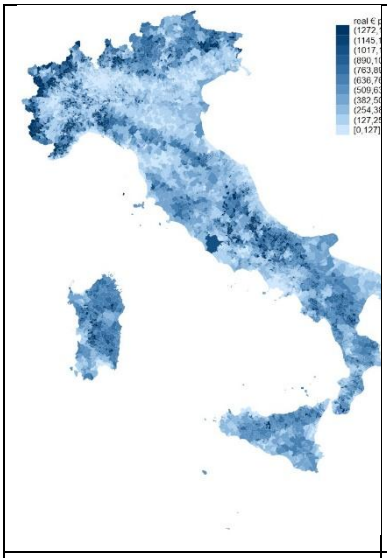
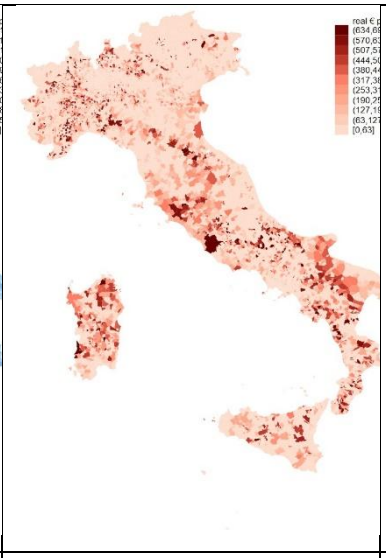
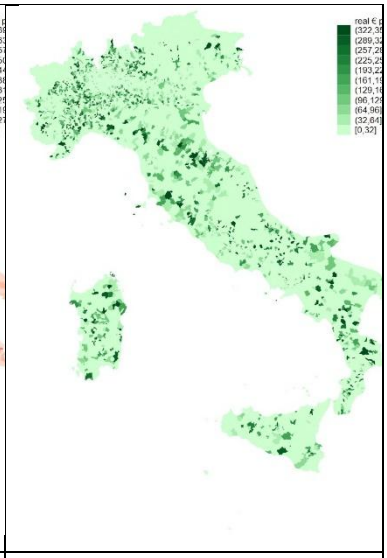
		
CSEXP **Cultural services Standard Capital Expenditure (average over 2016-2022)** **(a)**	**CGAP** **Cultural services Capital expenditure Gap 2022 = (Standard capital expenditure – Historical Capital expenditure 2022, if Standard > Historical)** **(b)**	**CGAP2022 – CGAP2016** **Cultural services Gap improvement (Gap 2022 – Gap 2016. if Gap 2022 < Gap 2016)** **(c)**

Figure 9: Total capital expenditure gap, euro per capita

		
TSEXP **Total services Standard Capital Expenditure (average over 2016-2022)** **(a)**	**TGAP** **Total services Capital expenditure Gap 2022 = (Standard capital expenditure – Historical Capital expenditure 2022, if Standard > Historical)** **(b)**	**TGAP2022 – TGAP2016** **Total services Gap improvement (Gap 2022 – Gap 2016. if Gap 2022 < Gap 2016)** **(c)**

4. Discussion

The environmental dimension of the infrastructural gap in waste management services measures how inadequacies affect ecological systems. It focuses on aspects like pollution levels (air and water), waste accumulation (landfill overflow and illegal dumping), resource depletion (recycling rates and waste diversion), and biodiversity impact (habitat disruption and species at risk). This indicator helps governments assess the effectiveness of their waste management systems and guides policy decisions to address infrastructure gaps.

The static dimension of the infrastructural gap in waste management service focuses on the status and characteristics of existing waste management facilities. It typically includes data such as the number and capacity of waste processing and disposal facilities, the geographical distribution of

these facilities, and the extent of technological adoption (e.g., advanced recycling processes and waste-to-energy systems). This dimension helps in understanding the baseline infrastructure available and identifies areas lacking sufficient waste management capabilities, crucial for strategic planning and development.

The accessibility dimension of the indicator for the infrastructural gap in the transport and road maintenance sector for municipalities evaluates how limitations in infrastructure affect transportation efficiency and access. It concentrates on aspects such as road network density (coverage of roads in relation to area and population), road condition (percentage of roads in good, fair, and poor condition), public transport availability (frequency and reach of buses, trams, etc.), and connectivity (ease of access to main economic centres and services). This indicator assists local governments in assessing the adequacy of their transportation networks and supports decision-making to enhance mobility and accessibility across municipalities.

The static dimension of an indicator for the infrastructural gap in the local transport and road maintenance sector of municipalities focuses on the status and characteristics of existing transport infrastructure. It typically includes data such as the length and condition of road networks, the number and types of public transportation facilities (bus stations, tram lines, etc.), the geographical distribution of these assets, and the extent of technological adoption (e.g., smart traffic management systems, electronic toll collection). This dimension aids in understanding the baseline transport infrastructure available and identifies areas lacking sufficient road maintenance and transportation services, crucial for strategic planning and urban development.

The attractiveness dimension of the indicator for the infrastructural gap in the cultural sector of municipalities measures how inadequacies affect the sector's appeal and vitality. It focuses on aspects like the variety and quality of cultural offerings (performances, exhibitions, workshops), the condition and appeal of cultural facilities (museums, theatres, galleries), community engagement levels, and the economic impact of cultural activities (tourism, local business support). This indicator helps local governments assess the attractiveness and competitiveness of their cultural infrastructure and guides policy decisions to enhance the cultural appeal, drawing both residents and visitors to enrich the local community.

The static dimension of the indicator for the infrastructural gap in the cultural sector of municipalities focuses on the current status and characteristics of existing cultural facilities and services. It typically includes data such as the number and types of cultural institutions (museums, theatres, libraries, etc.), the capacity and utilization rates of these facilities, the geographical distribution across the municipality, and the extent of technological adoption (e.g., digital archives, online access to collections). This dimension aids in understanding the baseline

cultural infrastructure available and identifies areas lacking sufficient cultural services, crucial for strategic planning and enhancing cultural accessibility and engagement.

The resilience dimension of an indicator for the total capital expenditure in infrastructural services provided by municipalities measures how robustly these services can withstand and adapt to various challenges. It focuses on aspects like the durability and maintenance of infrastructure (roads, bridges, public buildings), the flexibility of systems to adapt to technological advancements and changing needs (upgradable transport systems, modular cultural venues), emergency preparedness levels (flood defenses, earthquake-resistant structures), and the financial sustainability of infrastructure investments (long-term funding strategies, efficient allocation of resources). This indicator helps local governments assess the resilience and long-term viability of their infrastructure across all sectors, guiding policy decisions to bolster resilience, ensure continuity of services, and enhance overall community stability.

The static dimension of the indicator for the total capital in infrastructural services provided by municipalities focuses on the current status and characteristics of existing infrastructure across all sectors. It typically includes data such as the number and types of public facilities (roads, bridges, public buildings, cultural institutions), the capacity and current usage rates of these facilities, the geographical distribution throughout the municipality, and the extent of technological adoption (smart city technologies, digital traffic management systems, online public services). This dimension aids in understanding the baseline infrastructure available and identifies areas lacking sufficient resources, crucial for strategic planning and enhancing service delivery and accessibility across the community.

5. Conclusions and policy implications

The disparities in infrastructure endowments across Italian municipalities, as evidenced by the analysis of gap indicators for waste management, transport, and cultural services, necessitate a targeted approach to infrastructure investment. A prioritization strategy is essential, focusing on allocating resources to regions exhibiting the most significant infrastructural gaps to promote equitable development and enhance national connectivity and competitiveness.
Enhancing the fiscal capacity and autonomy of municipalities is paramount, especially given the notable discrepancies between northern and southern regions. Policies should aim to revise the current allocation formulas to provide increased support to regions with limited fiscal capabilities, thereby enabling them to undertake necessary capital investments. Additionally, municipalities should be encouraged to improve their financial management and planning capacities through access to better financial tools, resources, and training programs.

As sustainability and resilience become increasingly critical in municipal planning, local governments should focus on developing infrastructure that meets current needs while anticipating future challenges. This approach includes promoting the adoption of green infrastructure practices in waste management to enhance environmental sustainability and integrating climate resilience into infrastructure planning, especially in vulnerable southern and coastal areas.

The foundation of effective infrastructure policy is robust data collection and monitoring. Enhancing the capabilities of the BDAP to ensure more detailed and frequent data collection will be crucial. Implementing standardized reporting and evaluation frameworks across municipalities will enable more effective comparisons and benchmarking, allowing for better-targeted interventions.

Moreover, public-private partnerships (PPPs) represent a significant opportunity to leverage private sector expertise and funding to supplement public investments in infrastructure. Developing a regulatory framework that encourages private investment in public infrastructure projects and offering incentives for private entities to invest in regions with significant infrastructural deficits can dramatically enhance the scope and scale of infrastructure development.

Finally, a concerted effort must be made to address the stark regional disparities highlighted by the infrastructural gap analysis. This involves designing targeted interventions that specifically address the unique challenges faced by rural and southern municipalities and increasing transparency in the distribution and utilization of funds to ensure accountability and efficient use of resources.

Through these comprehensive and strategically focused actions, Italy can create a more balanced developmental landscape across its municipalities, ensuring that infrastructure investments are both strategic and inclusive. This approach will foster long-term economic growth and stability, ensuring that all regions are equipped to meet the challenges of the future effectively.

In addressing the significant regional disparities between northern and southern Italy, as highlighted in the infrastructure gap analysis, it is crucial to tailor policies that specifically cater to the unique challenges faced by different regions. The stark differences in expenditure capacity and infrastructural endowments underscore the necessity for targeted interventions to ensure equitable development across all Italian municipalities.

The analysis reveals that southern municipalities face notable challenges in translating planned investments into tangible projects, with their capital expenditure capacities generally falling below the national average. This contrast sharply with northern municipalities, which not only meet but often exceed the national benchmarks in terms of executing planned investments efficiently.

To mitigate these regional disparities, the following policy implications are drawn from the document's findings:

Revising Allocation Formulas: There is a critical need to adjust the allocation formulas used to distribute funds across municipalities. These formulas should be designed to provide additional support to southern regions, where fiscal constraints significantly hinder local governments' ability to finance and implement necessary infrastructure projects. By ensuring that these regions receive a proportionate share of national investments, Italy can promote a more balanced economic development.

Enhancing Fiscal Autonomy: Policies aimed at enhancing the fiscal autonomy of southern municipalities could empower them to make strategic decisions that align with their specific developmental needs. Increasing fiscal autonomy involves not only reallocating resources but also building local capacities in financial management and strategic planning.

Infrastructure Development Incentives: Establishing incentives for infrastructure development specifically in the south can attract private investments and public-private partnerships, which are crucial in areas lacking adequate public funding. These incentives could include tax breaks, subsidies, and other financial benefits to encourage investment in infrastructure projects that address critical gaps.

Focused Investment in Critical Sectors: Identifying and investing in critical sectors such as transportation, public services, and environmental infrastructure in southern regions can significantly impact overall regional development. Such investments should aim to improve connectivity, enhance service delivery, and promote sustainable practices, directly addressing the infrastructural deficits that impede economic growth.

Transparent Monitoring and Reporting: To ensure that the interventions are effective and that funds are used efficiently, establishing a robust monitoring and reporting system is essential. This system should provide transparency in how resources are allocated and spent, allowing for adjustments in policies and strategies as needed to better serve the target regions.

By implementing these policy measures, Italy can address the profound disparities between its northern and southern regions, promoting a more equitable and sustainable development path that leverages the unique strengths and addresses the specific needs of each area. This approach not only aligns with principles of fiscal federalism but also ensures that all Italian municipalities are equipped to contribute to the nation's overall prosperity.

6. References

Dafflon, B., Mischler, P., 2007. Measuring Local Government Expenditure Needs. The Copenhagen Workshop 2007, Ch. Expenditure needs equalisation at the local level: methods and practice.

Goldsmith, R. W., 1951. Part i, a perpetual inventory ol national wealth. In: Studies in Income and Wealth, Volume 14. National Bureau of Economic Research, Inc, pp. 5–74.

Herrero-Alcalde, A., Martinez-Vazquez, J., Murillo-Garca, E., 2010. Capital Transfers and Equalization: An Application to Spanish Regions. Tech. Rep. paper1025, Inter- national Center for Public Policy, Andrew Young School of Policy Studies, Georgia State University.

Levtchenkova, S., Petchey, J., 2007. A model for public infrastructure equalization in transitional economies. In: Martinez-Vazquez, J., Searle, B. (Eds.), Fiscal Equaliza- tion. Springer US, pp. 345–362.

Mazziotta, C., 2005. Statistica economica e strumenti di analisi, Scritti in memoria di Antonino Giannone. Roma, Istituto per la Contabilita' Nazionale (Iscona), published by Istat, Ch. La stima del capitale pubblico a livello regionale: una riflessione di metodo, pp. 139 – 175.

Petchey, J., Koshy, G. M. P., Shapiro, P., 2000. Capital equalization and the australian states. Economic Record 76 (232), 32 – 44.

Porcelli F., Vidoli F., Dispotico R. and Ballanti D. 2016. Measuring public sector performance: a four quadrants model to monitor local governments' efficiency. in "Public Sector Economics and the Need for Reforms", MIT Press.

Porcelli F. 2015. "The Evaluation of Standard Expenditure Needs of Municipalities: The Case of Social Care Services in Italy". The Italian Journal of Public Economics, 3:123-157.

Reschovsky, A., 2007. Intergovernmental fiscal transfers: principles and practice. R. Boadway and A. Shah, Ch. Compensating Local Governments for Differences in Expenditure Needs in a Horizontal Fiscal Equalization Program.

Sharma, C., Bhanumurthy, N. R., 2011. Estimating infrastructural investment needs for india. The Journal of Applied Economic Research 5 (2), 221 – 243.

Vidoli, F., Fusco, E., Mazziotta, C., 2014. Non-compensability in composite indicators: A robust directional frontier method. Social Indicators Research http://dx.doi.org/10.1007/s11205-014-0710-y.

Witte, K. D., Rogge, N., 2009. Accounting for exogenous influences in a benevo- lent performance evaluation of teachers. Tech. rep., Working Paper Series ces0913, Katholieke Universiteit Leuven, Centrum voor Economische Studien.

Sharma, C., Bhanumurthy, N. R., 2011. Estimating infrastructural investment needs for india. The Journal of Applied Economic Research 5 (2), 221 – 243.