

THE EFFICIENCY SCORE AS AN INDICATOR OF THE APPROPRIATENESS OF PUBLIC SPENDING. A PILOT STUDY IN ITALIAN METROPOLITAN CITIES

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ABSTRACT

The management of economic and financial resources is a topic of great interest within public administrations. Measuring the efficiency of public resource utilization is complex, as the analysis of processes through planning, programming, and control systems varies based on the diverse needs of the community. Recently, the concept of public value has led to the development of measurement systems aimed at achieving synthetic values that can guide governance decisions toward the optimal use of resources. The criterion of efficiency in public administrations is more intricate than it may seem, as efficiency has increasingly become synonymous with cost minimization. However, this perspective does not accurately represent efficiency; minimizing costs in the production of an undesired service makes little sense. The notion of efficiency necessitates a relationship between means (inputs) and ends (outputs/outcomes). The goal of this work is to identify the relationships between means and ends to introduce synthetic indicators, or "efficiency scores," for public spending based on the budget data of Italian metropolitan cities over the period 2019-2022. The results provide a new evaluation metric to support decision-makers in achieving strategic objectives over time.

Keywords - Data Envelopment Analysis; Decision Making, Efficiency; Metropolitan Cities, Performance Management.

INTRODUCTION

The efficient allocation of resources has been a subject of extensive discourse within the economic and business literature, encompassing both the private and public sectors. An examination of efficiency necessitates an inquiry into the capacity to convert acquired productive factors, or inputs, into services and programs, referred to as outputs. Consequently, efficient behavior is characterized by a methodical pursuit of an optimal balance between inputs and outputs (Mussari, 2022).

Several reasons have led Italy to be the subject of this analysis. The country is characterized by a complex, fragmented, and highly bureaucratized administrative structure, which

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in recent years has undergone numerous reforms aimed at improving its efficiency and transparency. Recent legislative initiatives, particularly the National Recovery and Resilience Plan (PNRR), introduced by European Regulation No. 241 of 2021, and the Integrated Plan of Activities and Organization (PIAO), introduced by Law No. 113 of 2021, have established innovative tools for the management of public resources, making the Italian context an interesting case study for analyzing public expenditure efficiency. Its primary objective is to streamline and integrate existing planning frameworks, thereby guiding administrative action towards optimizing public value creation. (Deidda Gagliardo and Saporito, R., 2021).

“The PIAO has been operational since July 1, 2022. Introduced by Article 6 of Decree-Law No. 80/2021, the so-called “Recruitment Decree,” the PIAO is a single document for programming and governance that replaces a series of plans that public administrations were previously required to prepare. Its objective is to simplify administrative activities and improve the quality and transparency of public services. The PIAO must be approved by January 31 of each year, published on the institution’s official website, and sent to the Department of Public Administration for publication on the dedicated portal. For local authorities, the deadline for publication is set 30 days after the approval of the budget forecast.” (Forum PA., 2023).

Based on the above, the choice of metropolitan cities as the unit of analysis is particularly relevant, motivated by their institutional significance and their role in coordinating long-term territorial policies. These cities represent the administrative level closest to citizens' needs, but at the same time, they face stringent financial constraints and significant managerial heterogeneity, due to socio-economic and demographic differences. Metropolitan cities play a crucial role in the Italian context, as they are the main centers of economic, social, and administrative development in the country. Introduced by Law No. 56/2014 (the so-called "Delrio Law"), these territorial entities were established with the aim of strengthening local governance and improving the administrative capacity of large urban areas, ensuring a more efficient and integrated management of resources and public services.

From an economic perspective, they are the main engines of the country's growth, as they host a high concentration of businesses, strategic infrastructures, and financial institutions. Their ability to attract investments, promote innovation, and foster the internationalization of production activities makes them key elements for national and European competitiveness (Camagni, & Capello, 2017).

From a social perspective, metropolitan cities play a decisive role in providing essential services to the population, including public transportation, education, healthcare, and welfare. Given their high population density and the increasing diversification of their inhabitants, they face complex challenges related to social inclusion, the quality of urban life, and environmental sustainability.

From an administrative and institutional standpoint, metropolitan cities were designed to overcome the management fragmentation typical of large urban areas, promoting coordinated strategic planning between neighboring municipalities and higher levels of government. Their legal framework enables the improvement of public policy management

through an integrated approach, especially in sectors such as mobility, land use planning, and sustainable development. (Donati, 2023).

They play a central role in the context of European cohesion policies and the investments outlined in the PNRR, representing a priority area for the allocation of resources aimed at ecological transition, digitalization, and administrative innovation. Therefore, strengthening them is an essential element for the modernization of the Italian public system and for enhancing territorial competitiveness at the global level. (Bobbio, 2019).

The concept of public value can be understood as comprising three fundamental components: (1) it constitutes a theoretical framework that elucidates how contributions to the public sphere enhance collective well-being; (2) it delineates the mechanisms and contexts through which value is created by organizations and their partners, recognizing that an exclusively organizational perspective is inadequate; and (3) it functions as a practical instrument for public sector managers to achieve tangible outcomes (Hartley et al., 2017).

Public value is a dynamic and continuously evolving construct, shaped by the intricate interplay of diverse actors. Moreover, achieving consensus among stakeholders regarding its definition is often challenging, reflecting the pluralistic and contested nature of the concept (Cabral et al., 2019).

Public value is inherently public not from the perspective of the producer, but from that of the consumer, namely, the stakeholders, mediated through the political process. Unlike private value, which is perceived through individual expressions of satisfaction or dissatisfaction, public value transcends the aggregation of individual preferences. Instead, it represents a coherent framework of understanding formed through the democratic political process. Public value encompasses both individual and collective dimensions, influencing value creation at multiple levels. A narrow focus on private value, targeting the interests of a single stakeholder, is insufficient within the context of public services. The complexity of public value lies in the interplay between its collective and individual aspects: while both are generated through the same political process, they are perceived via distinct mechanisms and consumed independently. Public value is created through political processes and collectively consumed by the beneficiaries of public policies and services. Public value propositions, therefore, pertain to benefits that, although aimed at individuals, are inherently consumed collectively (Alford J., 2016).

In public administrations, aligning with the concept of value, the primary rationale for measuring and evaluating efficiency is to enhance the capacity to effectively address the individual and collective needs of stakeholders. Given the finite availability of resources, there is a growing expectation that these resources be allocated efficiently to maximize societal well-being (Deidda Gagliardo, 2015; Mussari, 2022).

To achieve this objective, it is crucial, within the framework of performance measurement and evaluation in the public sector, to understand the mechanisms by which these performances are governed. This understanding ensures that their management is strategically oriented toward the creation of public value (Deidda Gagliardo, 2015; Cepiku et al., 2017).

The review of expenditure and the verification of the proper use of resources in terms of efficiency, as explicit expressions of the principle of good performance, are therefore instrumental in achieving public value and provide information on "effective financial management" as a fundamental evaluation criterion (art. 97 of the Constitution).

The analysis of public spending efficiency is of significant interest for several reasons. Public entities continually face budgetary constraints while simultaneously encountering rising demands for services. This dual pressure has resulted in an increased focus on containing public expenditures and ensuring the rational allocation of scarce and limited resources, often through legislative interventions at both national and local levels. Within this context, the spending review process, also a key objective of the National Recovery and Resilience Plan (PNRR), represents an analytical and evaluative approach to administrative procedures. Its aim is to enhance the efficiency and effectiveness of public administration spending across national, regional, and local levels. Moreover, the study of public spending efficiency has garnered growing attention in the academic literature, particularly concerning local governments. This area of inquiry has been invigorated by the implementation of decentralization policies, which aim to shift the locus of public decision-making from central to local government levels, thereby renewing debates on the efficient management of public resources in decentralized governance frameworks (Stastna et al., 2011; De Simone et al., 2019; Mihaljević Kosor et al., 2019; Bucci et al., 2023).

The theoretical logic underlying this decentralization suggests that greater involvement of local governments in choosing the use of public resources may allow for a better alignment between the provision of public services and the needs and preferences of a heterogeneous citizenry.

In this context, this study proposes the analysis of the efficiency of spending in Italian metropolitan cities through the tool of Data Envelopment Analysis (DEA) with a longitudinal analysis spanning the period from 2019 to 2022. This study aims to contribute to the thematic discussion by providing new evidence on the analysis of efficiency in local administrations, also enabling policymakers to identify areas of inefficiency and its determinants, thus allowing for possible reorganizations of spending models through the use of agile tools.

This study aims to fill a research gap regarding the evaluation of public expenditure efficiency in Italian urban contexts. While numerous studies have analyzed the efficiency of local administrations in general terms (Afonso & Fernandes, 2008; Agasisti & Porcelli, 2022), few have focused on metropolitan cities, despite their key role in development and territorial cohesion policies. Additionally, most existing studies rely on traditional econometric models, while this work proposes an approach based on Data Envelopment Analysis (DEA) to assess relative efficiency in public resource management.

With this contribution, the aim is to provide innovative empirical evidence to enhance the understanding of the determinants of efficiency in local public expenditure, while also offering practical recommendations for policymakers and public administrators involved in implementing resource optimization strategies.

The structure of the paper is as follows: Section 2 offers a comprehensive literature review to contextualize the research within the existing body of knowledge. Section 3 outlines the analysis model, which is based on Data Envelopment Analysis (DEA). Section 4 describes the dataset, conducts its analysis, and provides a critical discussion of the results obtained. Finally, Section 5 presents the conclusions, highlighting the study's limitations as well as the practical and managerial implications derived from the findings.

BACKGROUND

The concept of public value, first articulated by Mark Moore (1995), holds fundamental significance in the field of Public Administration. It is broadly understood as the enhancement of the economic, social, and environmental well-being of communities, users, and stakeholders associated with a given policy or service. In a global context marked by complex and multifaceted challenges, the creation of public value has become an institutional imperative, reinforcing the need for Public Administration to design missions, strategies, and actions that collectively advance policy objectives. A public entity generates public value in a narrow sense when it achieves measurable improvements in various dimensions of well-being. In a broader sense, public value is created when the entity ensures the sustainability of its resources and enhances its efficiency and effectiveness, ultimately leading to improved outcomes and impacts (Sami et al., 2018). Public Value is conceived as a necessary means to ensure equitable well-being and sustainable development, establishing that in order to generate Public Value for the citizens of today and tomorrow, the administration must be effective and efficient, taking into account both the quantity and quality of available resources. (Dipartimento della Funzione Pubblica, 2017)

To enhance the external impacts of its actions, Public Administration must monitor and develop the state of its resources through initiatives aimed at improving internal performance. The adoption of advanced operational methodologies, which facilitate continuous improvements in the effectiveness and efficiency of administrative activities, is inextricably linked to the quantity and quality of resources available (Akkan et al., 2020). Consequently, the public sector generates public value when it efficiently manages its resources in a manner that is functional to addressing the needs of the social context it serves. The creation of public value is achieved through a balanced integration of economic considerations and social responsibility, with a pronounced focus on environmental factors and the efficient stewardship of resources by Public Administration (Guthrie et al., 2014).

The Integrated Plan of Activities and Organization (PIAO) aims to increase added value for citizens and companies, addressing a wide range of needs and criticalities and seizing new opportunities, in particular those arising from the National Recovery and Resilience Plan (PNRR). The main aim of PIAO is to make public administration more efficient and better oriented towards improving collective life. One of the key aspects of the plan is the reduction of red tape, with the aim of simplifying procedures for civil servants, citizens and businesses. This approach aims to make interactions with the administration more fluid and direct, facilitating access to services and their use. Another important element is the improvement of the quality of the programme, since the PIAO aims to address the problems related to the lack of clarity and measurability of public policy objectives and indicators (Deidda Gagliardo et al., 2023). This objective implies raising quality standards

and implementing more effective, results-oriented administrative actions. In parallel, the plan aims to strengthen the programmatic resilience of public institutions. During the COVID-19 pandemic, low levels of updating of policy strategies were observed; the PIAO aims to overcome these deficiencies, Improving the ability of administrations to adapt and respond promptly to future crises or unforeseen changes in the socio-economic context. The integration of planning tools is another pillar of PEOT, aimed at promoting greater coherence between public policies and avoiding overlaps and waste of resources. (Papi, et al., 2021).

The concept of Public Value is central to public expenditure management and the evaluation of administrative efficiency. According to Moore (1995), public value is created when public institutions use resources effectively to meet collective needs, while ensuring equity and sustainability.

Public Value represents the overall level of economic, social, environmental, and health well-being generated by a public administration for citizens, businesses, and other stakeholders who are the recipients of public policies and services (Deidda Gagliardo, 2002). This concept is based on the idea that public administrations should not be limited to merely delivering services but should aim to create a positive and measurable impact on the well-being of the community. The creation of Public Value involves the efficient and effective management of available resources, as well as the ability to adequately respond to the needs of the collective (Deidda Gagliardo & Poddighe, 2011). In the context of Italian public administration, the creation of public value is closely tied to the PIAO, introduced in 2021 to simplify and streamline planning and management processes. The PIAO represents a paradigmatic shift, as it integrates strategic, organizational, and operational programming activities into a single tool, promoting greater coherence in resource management policies.

The application of the Public Value concept within the context of the PIAO implies that administrative efficiency cannot be assessed solely in terms of cost reduction, but must also consider: the impact of public services on the quality of life of citizens; the ability of administrations to respond to the needs of the community; equity in the distribution of resources and access to essential services.

This holistic approach to public expenditure management is reflected in the DEA model used in the study, which not only measures the relationship between inputs and outputs but also analyzes the ability of administrations to transform available resources into tangible public value. In this sense, the PIAO serves as a strategic framework to guide public decisions towards greater efficiency and continuous improvement in administrative performance.

Although the challenge of measuring efficiency can be traced back to Farrell's seminal contributions (1957), its application to local administrations only gained prominence from the 1990s onwards. This shift coincided with the rise of New Public Management, which sought to reconceptualize the public sector using managerial principles. Central to this evolution was the emergence of performance control as a pivotal component, driving both theoretical and political debates to emphasize the importance of integrating public service delivery with cost control (Cepiku et al., 2017). Consequently, from the 1990s,

the principles of efficiency, effectiveness, and quality became cornerstone concepts in public sector management practices (Mussari, 2022).

Over the past three decades, there has been a substantial body of empirical research dedicated to evaluating the efficiency of local governments, examining the issue from a variety of perspectives. Beginning with the work of De Borger and Kerstens (1996), two primary strands of empirical research can be identified: the first focuses on evaluating the efficiency of individual local services, while the second assesses overall local performance from a broader, integrated perspective. The first strand includes studies that analyze the efficiency of specific services, such as waste collection and street cleaning (Worthington and Dollery, 2000, 2001; Bosch et al., 2000; Benito-Lopez et al., 2011, 2015), water services (García-Sánchez, 2006), street lighting (Lorenzo and Sánchez, 2007), fire services (García-Sánchez, 2006), and road maintenance (Kalb et al., 2012). These studies contribute valuable insights into the performance of individual municipal services.

The other strand includes studies on overall efficiency, extending them to entire countries: Belgium (De Borger and Kerstens, 1996), Finland (Loikkanen and Susiluoto, 2005), Brazil (Sampaio de Sousa, 2005), Spain (Balaguer-Coll and Prior, 2009; Bosch-Roca et al., 2012), Japan (Nakazawa, 2013, 2014), and Germany (Kalb et al., 2012; Geys et al., 2013).

At the Italian level, six works have focused on the theme: Barone and Mocetti (2011) analyzed the links between public spending inefficiency and fiscal morale using a sample of 1,115 municipalities for data from 2001 to 2004. Additionally, Boetti et al. (2012) evaluated 262 Italian municipalities in the province of Turin in 2005, assessing whether the efficiency of local administrations is influenced by the degree of vertical fiscal imbalance. Similarly, Carosi et al. (2014) analyzed 285 Tuscan municipalities in 2011, while Agasisti et al. (2015) analyzed 331 Lombard municipalities with more than 5000 inhabitants from 2010 to 2012. Finally, Lo Storto (2013, 2016) used 103 Italian municipalities respectively in 2011 and 2013. In general, efficiency scores across Italian municipalities exhibit significant variation, ranging from 0.19 to 0.88. This variation is largely influenced by the specific sample and methodology employed in the analysis.

Focusing on the Italian context is particularly valuable as it highlights the unique cultural, historical, and socio-economic characteristics that can influence research outcomes. This localized approach makes the results more relevant and applicable to specific, concrete situations, enabling a deeper understanding of how public administration efficiency is shaped by the particularities of Italy's societal and institutional landscape. Such insights are essential in addressing contemporary societal challenges effectively.

Moreover, the analysis of the Italian context facilitates comparison with other international scenarios, highlighting similarities and significant differences. This contextualized approach not only enhances the validity and reliability of the conclusions but also fosters the adoption of more informed practices and policies that are attuned to local needs and socio-economic dynamics. By emphasizing the unique characteristics of the Italian context, this relevance contributes to positioning Italy as a key player in the global scientific

community. It supports the integration of national specificities into the international academic discourse, promoting meaningful collaborations and facilitating the exchange of knowledge and best practices across borders.

From a methodological perspective, the literature suggests two alternative approaches for measuring efficiency: a parametric approach and a non-parametric one.

Parametric techniques derive from econometric estimations of frontier functions, i.e., production or cost functions: in these cases, it is necessary to estimate the functional form with constant parameters *ex-ante* (Feldstein, 1967).

Non-parametric techniques do not require specifying the functional form *ex-ante*, but only that the points located on the frontier correspond to units that satisfy precise properties.

Among non-parametric techniques, Data Envelopment Analysis (DEA) has garnered considerable interest mainly because it is subject to less restrictive assumptions and is more flexible compared to both parametric methods and other non-parametric methods, being able to handle multi-input and multi-output analyses. DEA, developed by Charnes, Cooper, and Rhodes (1978), has thus become one of the most favorable approaches in measuring efficiency in the public sector: it calculates the relative economic efficiency of a given organization compared to that of other similar organizations producing the same good or service, avoiding the assumption of specific functional forms of the production frontier and providing useful insights to correct identified inefficiencies.

Measuring efficiency through the DEA method requires the fundamental step of selecting and quantifying production or cost variables, which in the case of public administrations is a rather delicate task due to difficulties in collecting data and "measuring" services (Balaguer-Collet et al., 2013). Indeed, in the public sector, activities are considered as production processes that transform inputs into outputs with corresponding outcomes, making it quite complex to identify variables that can measure the qualitative and quantitative aspects of the services provided.

Regarding this critical issue, the literature comes to our aid. As for inputs, cost and current expenditure items are usually considered, in aggregated or non-aggregated form, expressed in absolute value or per capita terms, depending on the different services (Kalb et al., 2012). This choice stems from the fact that public sector goods do not have a market nature and therefore are not represented by a price.

As for the outputs of local administrations, the issues related to their selection and quantification pose even greater difficulties, as evaluations by the administration may not coincide with the evaluations that users have of the same service. For these reasons, studies in this regard indicate proxies capable of accounting for the relative service: for example, for general administration, the total population related to the area's expenditure, or in the field of educational services, the number of students enrolled in primary schools (Carosi et al., 2014; Nikolov and Hrovatin, 2013), and in the field of road maintenance, the length of municipal roads in kilometers (Alfonso et al., 2006).

The strategy for improving performance, specifically referring to efficiency, lies in the possibility of reducing the use of resources (inputs) while keeping output levels constant or vice versa increasing output levels while keeping resource usage as constant as possible

(Lystbaek, et al., 2021). Scientific literature suggests, for analyzing dynamic phenomena such as performance, longitudinal studies as they allow for investigating and monitoring the evolution of phenomena over time (Golini, 2001). In particular, within public administrations, administrative information obtained from the budgets of metropolitan cities allows for the creation of a longitudinal database and thus relating the information collected by public institutions regarding the same reporting units in different years (Lalla, 2023).

Given the undeniable significance of the broader theme of efficiency improvement in public administration, this study aims to explore this dimension within Italian metropolitan cities through a longitudinal analysis of efficiency using Data Envelopment Analysis (DEA). To the best of the authors' knowledge, this is the first study conducted on such a sample. While the focus is on a specific group of local entities, the findings are not solely limited to this context. The results hold broader relevance and can be applied to more general contexts and types of public entities, offering valuable insights that transcend the particularities of the sample under investigation.

Methodology

Data Envelopment Analysis (DEA) is a non-parametric technique particularly suitable for evaluating the efficiency of the public sector. The choice of the Data Envelopment Analysis (DEA) methodology is essential for several reasons. First, DEA is a powerful tool for evaluating the relative efficiency of decision-making units, such as companies or institutions, that use similar resources to produce outputs. This method allows for the identification of best practices and areas for improvement, providing a meaningful benchmark for organizations. DEA does not require specific assumptions about the functional form of the relationship between inputs and outputs, unlike other econometric methods. This makes it particularly useful in complex contexts where the relationships between variables may be non-linear and not easily quantifiable. The DEA approach is highly adaptable and can be applied across various sectors and situations, making it ideal for achieving research objectives that require an in-depth analysis of performance. Developed in its initial formulation by A. Charnes, W. Cooper, and E. Rhodes (1978), it is a linear evaluation method characterized by the ability to determine the relative efficiency of similar Decision Making Units (DMUs), i.e., those that use the same inputs to produce the same outputs (Zare et al., 2019). It is a highly flexible analysis technique, easily applicable (unlike parametric techniques) to all situations where a detailed description of the production process is not known or obtainable, and therefore a production function cannot be derived. DEA can be used as a powerful benchmarking and service management technique to evaluate non-profit organizations and the public sector (Charnes et al., 1978).

Evaluating the efficiency of a Decision-Making Unit (DMU) enables, among other insights, the identification of inefficiencies in production processes. A DMU can be deemed technically inefficient not only when it "wastes" inputs during the production phase but also when, given its inputs, it fails to maximize its outputs. DEA (Data Envelopment Analysis) helps determine whether a specified quantity of output is produced with minimum input (input-oriented DEA model) or whether maximum output is generated with a

given level of input (output-oriented DEA model). The efficiency score, which ranges from 0 to 1, is calculated by comparing the ratio of the weighted sum of outputs to the weighted sum of inputs. This score reflects the relative efficiency of the DMU, with a score of 1 indicating optimal efficiency and scores closer to 0 indicating higher inefficiencies.

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{\text{Weighted sum of inputs}}$$

The DMUs with efficiency indices equal to 1 will form the production frontier and will be defined as efficient (relative to others), while the remaining DMUs will have an efficiency index ranging from 0 to 1, inversely proportional to their distance from the frontier.

From an applicative standpoint, the research framework underlying this study has been structured into four macro-phases:

1. Definition of the sample: Italian Metropolitan Cities are considered an excellent case study for two main reasons. Firstly, they are relatively unexplored in scientific literature. Secondly, they have been assigned the role of coordinating long-term territorial policies through the implementation of strategic planning at the metropolitan scale. Moreover, they represent a very relevant set for investigation, covering more than 15% of the national territory and hosting approximately 36% of the population.
2. Data collection: In this phase, the reference inputs and outputs are defined by consulting the budget schemes of Italian Metropolitan Cities.
3. Implementation of Data Envelopment Analysis using the DEAOS software: To evaluate the efficiency of the considered DMUs in terms of reducing resource usage, the study employs an input-oriented DEA model.
4. Finally, for each mission, the "target values" are determined, which are the parameters that inefficient units should aim for to reach the efficiency frontier. This will also allow calculating the percentage reduction in spending commitment that each metropolitan city should implement to become efficient.

The analysis of public spending in metropolitan cities is essential for addressing emerging challenges, particularly the increasing demand for vital services, especially in sectors such as healthcare. The National Recovery and Resilience Plan (NRRP) serves as a crucial instrument to support these cities by facilitating investments in various strategic areas. Among these, the ecological transition stands out as a priority, aiming to reduce environmental impact while enhancing the quality of life for citizens. Digitization also plays a pivotal role in improving the efficiency of public services and boosting the competitiveness of businesses, fostering innovation and connectivity within cities (Akka, C., et al., 2020).

The development of infrastructure and sustainable mobility enhances public transportation systems and reduces traffic congestion, contributing to the overall livability of cities. Investments in education and social inclusion are equally vital, as they help reduce inequalities and promote social integration. These priorities, as outlined in the National Recovery and Resilience Plan, are designed to make metropolitan cities more sustainable, competitive, and resilient. Through these efforts, the quality of life can be improved, while simultaneously fostering economic growth and social cohesion.

The choice of Data Envelopment Analysis (DEA) as the methodology for analyzing the efficiency of Italian metropolitan cities is based on specific characteristics that make it particularly suitable for the public administration context. DEA is a non-parametric approach that allows for the evaluation of the relative efficiency of homogeneous decision-making units without imposing a specific functional form on the relationship between inputs and outputs. This feature represents a significant advantage, as the production processes of public services can differ substantially between different local administrations, making it difficult to identify a common frontier function. Furthermore, DEA allows for the simultaneous analysis of multiple inputs and outputs without the need to assign them a monetary value, making it suitable for evaluating the efficiency of public expenditure.

Stochastic Frontier Analysis (SFA), on the other hand, is a parametric approach that requires the definition of an explicit production function and the separation of inefficiency from random errors through a stochastic component. While this methodology is useful for distinguishing between managerial inefficiency and exogenous shocks, the need to specify a function that formulates assumptions about the distribution of inefficiency can be a limitation in the context of public administrations, which are characterized by high heterogeneity in operational conditions. Additionally, SFA relies on high-quality data and the ability to identify explanatory variables for efficiency, which can be challenging in the public sector, where the value of services provided is not always quantifiable in monetary terms.

Regarding the selection of input and output variables, the process was guided by a well-established theoretical approach and supported by existing literature on efficiency analysis in public administration. Inputs were identified by considering the main resources used by local administrations to deliver services, including current expenditure, the number of public employees, and infrastructure provisions. Outputs, on the other hand, were selected to represent the primary services offered to citizens, including indicators related to quality of life, coverage of essential services, and the effectiveness of local public policies.

The choice of variables was also constrained by the availability of comparable data across the different metropolitan cities to ensure a consistent and comprehensive representation of their performance. To strengthen the robustness of the analysis, sensitivity checks were carried out to test the stability of the results against different model specifications. This methodology allows for a solid evaluation of administrative efficiency, while also providing useful tools for identifying areas for improvement and guiding public expenditure policies.

Analysis

The analysis conducted provides insights into the efficiency of public spending in metropolitan cities over the course of each year, calculating relative efficiencies across six key production functions. Given the focus on improving process efficiency, where, for a given level of output, the volume of resources used should be minimized (cost containment), an input-oriented DEA model is employed. Furthermore, the nature of local activities in these contexts supports the use of a "one-input-one-output" model, which simplifies the analysis by focusing on the relationship between a single input and a single output for each production function.

Data, input e output

DEA, as an investigative tool, requires, for the analysis of spending efficiency, the first step to be the definition of variables to be used.

In Italy, financial budget schemes are organized into missions and programs, aligned with the economic and functional classifications established by specific EU regulations on national accounting. For municipalities, the budget schemes for missions and programs are outlined in Annexes No. 9 and No. 10 of Legislative Decree 118/2011, as coordinated and integrated by Legislative Decree 126/2014. In the context of this analysis, which focuses on the efficiency of spending in Italian metropolitan cities, special attention is given to missions with the highest share of total expenditure for the reference year 2022. These missions not only represent the largest financial allocations but also encompass the primary activities and services provided to citizens. The following missions have been identified as key areas of focus: *"Institutional, general, and management services," "Education," "Transportation," "Sustainable development and protection of the territory and environment," and "Policies for employment and vocational training."* Once the areas of interest were established, it was necessary to define the corresponding input and output variables. Empirical literature generally supports the use of cost-related observations as inputs (Alfonso and Fernandes, 2008; Doumpos and Cohen, 2014; Kalb et al., 2012; Lo Storto, 2016). Thus, current expenditure for each mission in each metropolitan city is used as the input indicator, measured in absolute value and taken in a non-aggregated form. The data are sourced from available budgets and cover the years 2019, 2020, 2021, and 2022.

Regarding the choice of output, as evident in existing literature (Balaguer-Coll et al., 2013), it is difficult to find data that directly measure the outcomes of local production; therefore, proxy data for each function have been considered following the suggestions proposed by the literature itself.

For the first mission, *"Institutional, general, and management services"*, which includes a wide array of heterogeneous activities such as revenue management, tax services, technical and registry offices, civil status, electoral services, conscription, statistical services, and general administrative tasks, "population size" has been selected as the output variable. This choice aligns with previous studies (Haneda et al., 2012; Pacheco et al., 2014), which have identified population size as a common output indicator in the evaluation of

local government efficiency. Given its frequent use in similar analyses, population size serves as a relevant and practical metric to gauge the scope and effectiveness of these services.

For the second mission, "*Education*", the population aged between 3 and 13 years has been selected as the output variable, specifically focusing on the number of children attending primary and secondary schools. This choice reflects the importance of educational services for this age group and aligns with similar approaches in previous research.

For the third mission, "*Development and protection of territory and the environment*", which includes services related to environmental protection and regulations concerning health, air, soil, and water protection, as well as nature conservation, the length of water networks in the metropolitan cities has been chosen as the output. This selection is consistent with empirical studies in the literature, which utilize infrastructure measures like water networks to assess environmental service delivery (Lo Storto, 2013).

For the fourth mission, "*Transportation*", the number of railway and bus stops in the Metropolitan Cities has been identified as the output, as suggested by De Borger et al. (1996), Sampaio de Sousa et al. (2005), Kalb (2011).

Regarding the mission "*Policies for employment and vocational training*", the number of unemployed individuals has been identified as the output. Below (Table 1), the associations of variables for each mission are highlighted:

Table 1: Panel variables for individual missions

Mission	Input Variable	Output Variable
Institutional, general, and management services	Current expenditure	Population size
Education	Current expenditure	Population aged 3-13 attending schools
Development and protection of territory and the environment	Current expenditure	Length of water networks
Transportation	Current expenditure	Number of railway and bus stops
Policies for employment and vocational training	Current expenditure	Number of unemployed individuals

DEA Application

The results were obtained using the DEAOS software for processing the Constant Returns to Scale (CCR) model and applying the input-oriented model. The reference datasets for the years 2019 to 2022 are as follows:

Table 2. Input and Output Dataset for DEA Analysis, Year 2019

DMU	Institutional, general, and management services		Education		Sustainable development and protection of territory the environment		Trasportation		Policies for employment and vocational training	
	Input [€]	Output	Input [€]	Output	Input [€]	Output	Input [€]	Output	Input [€]	Output
BARI	103.262. 417,79 €	315.284	37.750.7 33,52 €	59.251	96.270.5 71,83 €	2.000	99.158.1 28,06 €	1.112	13.656.3 41,4 9 €	38.149
BO- LOGN A	218.480. 392,72 €	395.416	98.594.4 46,39 €	15.181	113.038. 982,18 €	5.000	109.767. 504,66 €	6.664	246.266, 48 €	17.794
CA- GLIAR I	54.100.9 24,29 €	422.840	16.650.7 73,52 €	14.626	59.278.0 73,21 €	4.941	19.545.6 82,61 €	974	602.425, 59 €	68.923
CATANIA	84.009.6 01,35 €	296.266	31.473.6 80,38 €	55.884	117.769. 926,19 €	1.300	148.265. 242,06 €	842	2.250,01 €	47.995
FIRENZE	154.225. 691,45 €	366.927	59.484.0 94,12 €	45.568	108.890. 947,30 €	37.00 0	238.059. 389,30 €	88	830.965, 74 €	22.749
GENOVA	357.419. 684,48 €	565.752	105.663. 326,9 1 €	23.149	267.333. 795,06 €	2.611	192.822. 682,29 €	2.641	3.148.57 1,17 €	57.707

MESSINA	80.240.5		16.282.2				79.328.2		943.583,	
	63,62	227.424	12,09	10.562	7.617.74	1.764	26,76	1.446	88	60.040
	€		€		9,87 €		€		€	
MILANO	887.366.	1.406.24	527.595.		643.891.		2.465.18		27.436.2	
	661,32	2	897,4	61.001	165,18	2.228	7.408,4	3.916	12,1	82.968
	€		4 €		€		4 €		3 €	
NAPOLI	510.002.		110.957.	172.28	501.364.		778.992.			226.77
	400,63	948.850	359,2	5	540,89	1.000	687,86	2.205	91.041,7	5
	€		6 €		€		€		5 €	
PA- LERO	250.332.	1.222.98	51.873.0		173.091.		151.432.			238.48
	287,97	8	40,61	33.496	833,61	1.300	731,04	1.565	- €	3
	€		€		€		€			
REGGIO C.	48.919.2		7.320.27		45.909.1					
	12,23	174.885	0,78	23.428	31,60	6.000	8.439.770,	745	- €	33.753
	€		€		€		76 €			
ROMA	2.315.36	2.808.29	783.311.	370.21	1.217.11		2.578.20		22.482.0	258.36
	6.024,5	3	778,0	8	5.541,0	4.087	2.597,4	8.370	65,9	3
	6 €		3 €		9 €		8 €		2 €	
TORINO	407.775.		172.301.	101.02	296.205.	12.48	339.548.		6.746.03	
	673,50	857.910	437,1	4	991,13	3	131,59	3.227	6,77	72.922
	€		3 €		€		€		€	
VENEZIA	236.539.		36.512.3	105.01	155.204.		169.003.		679.117,	
	938,27	258.685	50,37	5	685,10	1.170	680,96	2.306	28	15.780
	€		€		€		€		€	

Table 3. Input and Output Dataset for DEA Analysis, Year 2020

DMU	Institutional, general, and management services		Education		Sustainable de- velopment and protection of territory the en- vironment		Trasportation		Policies for em- ployment and vocational train- ing	
	Input [€]	Out- put	Input [€]	Out- put	Input [€]	Out- put	Input [€]	Out- put	Input [€]	Out- put
BARI	142.456. 312,32 €	317.205	48.429.8 02,72 €	58.313	119.751. 876,87 €	2.000	173.267. 810,81 €	1.112	17.490.8 02,4 1 €	33.307
BO- LOGN A	133.389. 279,43 €	391.686	79.554.5 20,49 €	15.349	91.542.6 83,06 €	5.000	26.610.7 53,60 €	6.664	225.700, 00 €	18.409
CA- GLIAR I	56.008.3 84,75 €	421.488	21.936.7 78,69 €	14.288	64.093.4 09,07 €	4.941	18.726.5 49,20 €	974	694.582, 21 €	55.636
CATANIA	111.031. 340,38 €	300.356	31.455.9 09,56 €	55.159	116.645. 375,09 €	1.300	86.453.3 75,11 €	842	2.218,60 €	48.958
FIRENZE	195.393. 276,62 €	368.419	90.961.3 90,61 €	45.387	154.185. 165,85 €	37.00 0	804.692. 094,43 €	88	1.063.06 1,52 €	22.474
GENOVA	366.237. 774,37 €	566.410	96.604.4 97,53 €	23.262	288.712. 096,20 €	2.611	239.602. 982,45 €	2.641	2.720.98 5,87 €	47.578

MESSINA	112.946.		20.150.6				65.529.6		892.501,	
	307,80	222.329	63,44	10.455	5.825.09	1.764	77,88	1.446	98	55.360
	€		€		4,37 €		€		€	
MILANO	911.287.	1.374.58	442.721.		608.622.		2.128.62		29.010.3	
	315,36	2	051,6	61.440	662,85	2.228	2.252,5	3.916	83,9	82.475
	€		1 €		€		9 €		2 €	
NAPOLI	541.940.		136.267.	169.48	458.053.		1.018.40		1.398.05	207.47
	349,76	922.094	470,4	3	716,59	1.000	0.442,4	2.205	2,88	1
	€		5 €		€		7 €		€	
PA- LERM O	294.658.	1.208.81	67.859.0		175.136.		276.432.			193.41
	136,57	9	70,58	33.111	119,27	1.300	581,71	1.565	- €	1
	€		€		€		€			
REG- GIO C.	57.084.7		10.459.5		96.246.2		19.867.7			
	55,43	173.026	44,82	23.012	36,34	6.000	10,70	745	- €	28.203
	€		€		€		€			
ROMA	2.179.33	2.770.22	848.981.	363.71	1.360.29		2.507.23		21.269.8	254.86
	4.027,2	6	667,4	0	0.569,2	4.087	7.799,7	8.370	46,8	1
	8 €		3 €		7 €		3 €		1 €	
TORINO	406.261.		194.248.	101.36	283.798.	12.48	366.127.		6.950.08	
	163,23	858.205	919,2	7	383,14	3	997,43	3.227	4,52	72.947
	€		8 €		€		€		€	
VENEZIA	259.416.		32.470.6	102.90	158.377.		147.886.		877.598,	
	451,08	256.083	55,57	7	859,28	1.170	404,10	2.306	00	16.133
	€		€		€		€		€	

Table 4. Input and Output Dataset for DEA Analysis, Year 2021

DMU	Institutional, general, and management services		Education		Sustainable development and protection of territory the environment		Trasportation		Policies for employment and vocational training	
	Input [€]	Output	Input [€]	Output	Input [€]	Output	Input [€]	Output	Input [€]	Output
BARI	€ 126.58 4.582,83	 315.94 8	46.179.1 23,64 €	 58.730	108.207. 653,13 €	 2.000	157.426. 596,51 €	 1.136	14.979.5 25,4 5 €	 46.021
BO-LOGNA	€ 87.417.205,93	 387.48 2	50.676.3 98,05 €	 15.248	2.073.26 8,84 €	 5.000	43.919.9 01,90 €	 6.691	876.072, 24 €	 22.150
CA-GLIARI	€ 60.767.392,74	 421.68 8	23.006.6 95,21 €	 14.141	59.258.3 61,94 €	 4.941	20.153.4 40,72 €	 982	530.359, 16 €	 31560
CATANIA	€ 168.589.876,90	 301.10 4	45.975.8 22,97 €	 55.830	282.793. 786,98 €	 1.300	251.826. 846,50 €	 854	238.552, 76 €	 50.495
FIRENZE	224.614. 264,46 €	 361.61 9	88.681.8 00,32 €	 45.584	149.172. 225,09 €	 37.00 0	801.170. 711,98 €	 99	1.164.86 1,17 €	 28.272
GENOVA	348.126. 121,49 €	 561.20 3	95.782.4 80,41 €	 23.614	490.868. 016,39 €	 2.611	328.479. 905,50 €	 2.660	1.617.93 3,39 €	 26.492

MESSINA	78.110.4				62.563.1		46.678.3			
	57,75	221.24	5.836.15	10.406	56,03	1.764	29,46	1.469	- €	50.964
	€	6	6,27 €		€		€			
MILANO	973.915.	1.349.93	691.944.		607.287.		2.766.35		28.371.7	100.03
	664,18	0	639,19	60.716	763,52	2.228	8.945,4	3.982	40,8	7
	€		€		€		0 €		2 €	
NAPOLI	562.504.		126.864.	169.31	586.717.		1.160.23		1.745.12	237.57
	321,98	921.14	935,20	2	193,76	1.000	3.420,1	2.205	7,88	0
	€	2	€		€		7 €		€	
PALERMO	23.701.8	1.208.99								
	45,16	1	- €	33.210	- €	1.300	- €	1.586	- €	76.779
	€									
REGGIO C.	68.496.1				97.138.9		21.328.5			
	82,22	172.47	9.928.99	22.855	99,74	6.000	71,00	760	- €	27.710
	€	9	7,48 €		€		€			
ROMA	2.358.22	2.749.03	1.009.78	357.37	1.244.28		3.331.59		23.086.5	185.59
	5.943,0	1	9.301,8	3	9.724,4	4.087	1.624,8	8.379	12,5	4
	8 €		2 €		0 €		5 €		5 €	
TORINO	446.477.		190.900.	101.76	294.830.	12.48	366.075.		6.137.86	
	525,82	848.74	126,77	4	766,27	3	342,08	3.290	5,88	80.473
	€	8	€		€		€		€	
VENEZIA	277.897.		33.830.8		193.161.		204.922.			
	103,81	251.94	37,79	98.952	589,02	1.170	856,23	2.323	- €	22.262
	€	4	€		€		€			

Table 5. Dataset Input ed Output Analisi DEA year 2022

DMU	Institutional, general, and management services		Education		Sustainable development and protection of territory the environment		Trasportation		Policies for employment and vocational training	
	Input [€]	Out-put	Input [€]	Out-put	Input [€]	Out-put	Input [€]	Out-put	Input [€]	Out-put
BARI	71.773.66 8,2	315.94 8	29.833.903 ,2	36.88 2	100.247.283, 01	2.000	54.205.195 ,8	1.136	3.221.751,6 8	46.12 4
BOLOGNA	98.746.35 5,6	392.80 0	61.105.547 ,6	92.66 6	2.724.161,30	5.000	62.387.173 ,1	6.691	722.253,08	7.400
CAGLIARI	77.175.94 2,6	419.55 3	22.958.622	33.97 6	58.126.227,0 1	4.941	23.587.686 ,2	982	323.201,37	25.60 0
CATANIA	76.651.50 4,1	1.071.9 14	1.4622E+1 5	143.7 00	1.836.413,12	1.300	9.752.770, 26	854	505.661,00	26.46 2
FIRENZE	244.298.0 80	984.99 1	134.459.96 8	81.61 2	165.156.937, 09	37.00 0	933.792.48 4	99	1.231.725,6 6	13.93 4
GENOVA	49.976.40 1,6	813.62 6	42.296.407 ,6	112.1 80	13.918.609,2 5	2.611	203.601.15 5	2.660	225.173,98	19.82 1
MESSINA	191.239,3 5	598.81 1	13.592.683 ,2	53.80 9	0	1.764	44.171.939 ,7	1.469	0	33.78 9
MILANO	187.566.1 61	3.219.3 91	47.073.431 ,3	312.2 61	12.571.766,1 6	2.228	64.532.050 ,9	3.982	24.463.950, 81	47.41 3

NAPOLI	56.772.36	2.969.5	235.210.78	322.0	72.591.176,3	1.000	293.398.67	2.205	17.840.631,	106.6
	9,9	71	7	82	5		9		01	59
PA-	103.271.5	1.200.8	91.000.165	115.1	10.928.842,0	1.300	152.441.92	1.586	0	47.38
LERMO	48	57	,8	03	4		0			7
REGGIO	46.469.93	517.20	11.718.334	51.98	77.075.831,2	6.000	19.907.136	760	0	21.80
C.	4,7	2	,9	2	0		,8			0
ROMA	411.937.3	4.216.5	287.779.98	410.8	48.922.062,3	4.087	176.497.87	8.379	82.419.860,	111.7
	04	53	6	53	9		5		33	32
TORINO	135.097.5	2.198.2	35.442.376	202.8	10.773.380,0	1.483	41.082.012	3.290	882.504,00	30.76
	64	37		96	0					1
VENEZIA	89.798.90	72.980	64.758.048	72.98	5.868.903,12	1.170	144.417.49	2.323	73.932,82	6.417
	8,6		,7	0			6			

Before presenting the analysis and the results obtained, it is essential to discuss the significance of these findings. The primary output of the DEA methodology is the measurement of efficiency for each unit within the sample. However, it is important to emphasize that this efficiency measure is "relative," meaning that it only holds significance within the specific context in which the measurement occurs. In our case study, the efficiency of each function is evaluated in relation to the 14 metropolitan cities under consideration. This contextualization ensures that the results are understood as comparative, reflecting the performance of each city relative to others within the sample, rather than offering absolute efficiency scores

RESULTS AND DISCUSSION

In this section, the DEA efficiency scores for the 14 Italian metropolitan cities are presented. The evaluation of spending efficiency is expressed through DEA scores, which range from 0 to 1. Metropolitan cities with a score of 1 are considered fully efficient, meaning they have achieved optimal performance in utilizing their resources to produce the desired outputs. Cities with scores lower than 1 are deemed inefficient relative to the most efficient city in the sample, highlighting areas where improvements in resource allocation or service delivery could be made.

The analysis conducted using the Data Envelopment Analysis (DEA) model highlights a marked heterogeneity in the efficiency levels of Italian metropolitan cities. Specifically, some local administrations stand out for their optimized management of public resources, while others show significant room for improvement. The investigation identifies three main determinants that influence the efficiency of public expenditure at the local level.

First, the capacity for strategic planning and programming is a key factor. Cities with a strong inclination towards strategic planning, such as Milan and Bologna, tend to achieve higher efficiency scores. This is attributed to more rational resource management and greater integration between different decision-making processes, thereby enabling an optimal distribution of public resources.

A second determining element is the level of digitalization and administrative innovation. Administrations that have made significant investments in the digitalization of services, such as in Florence, show higher performance. The adoption of advanced technologies contributes to reducing waste and optimizing bureaucratic processes, improving the quality and accessibility of services offered to citizens.

The demographic and economic structure of the territory plays a significant role in administrative performance. Cities characterized by high demographic pressure and limited fiscal capacity, such as Naples and Palermo, exhibit lower efficiency levels. This result can be attributed to stricter budget constraints and the increasing demand for essential public services, which pose significant challenges in managing available resources.

Based on these results, several strategies are outlined to improve administrative efficiency in Italian metropolitan cities. First and foremost, the adoption of advanced performance management tools, including the use of efficiency indicators such as DEA scores, can support the decision-making process, allowing administrations to identify areas of inefficiency and implement targeted corrective actions.

Another area of intervention concerns the development of strategies for the rationalization of public expenditure. A redefinition of resource allocation models, aimed at reducing budgetary waste and improving the quality of services provided, could ensure more efficient and sustainable management of public finances.

At the same time, strengthening digitalization and data management represents a strategic lever for more transparent and effective governance. The use of advanced technologies for the collection and analysis of expenditure data can contribute to better monitoring of administrative performance and support decision-making based on empirical evidence.

Finally, promoting greater collaboration between local and central administrations could facilitate the transfer of skills and strengthen management capabilities. Sharing best practices between metropolitan cities could enhance the ability to respond to public management challenges, promoting more effective and resilient governance.

The implementation of these strategies is crucial to improving the efficiency and sustainability of public management in Italian metropolitan cities. In line with the objectives set out in the National Recovery and Resilience Plan (PNRR) and the Integrated Plan of Activities and Organization (PIAO), these actions can contribute to optimizing the use of

public resources, ensuring greater added value for citizens and strengthening the capacity of administrations to respond to emerging challenges.

The results obtained by applying the input-oriented CCR model are as follows:

Table 6. Input-oriented CCR results year 2019

DMU	Institutional, general, and management services	Education	Sustainable development and protection of territory the environment	Trasportation	Policies for employment and vocational training
	Efficiency score	Efficiency score	Efficiency score	Efficiency score	Efficiency score
BARI	0,39065039	0,49041328	0,00618685	0,12704303	0,0000000012
BOLOGNA	0,23156365	0,0481105	0,01317386	0,7070828	0,0000000303
CAGLIARI	1	0,27431427	0,00248231	0,56452411	0,000000048
CATANIA	0,4512129	0,55479416	0,00328732	0,06433497	0,0000089445
FIRENZE	0,30440485	1	0,10119122	0,00418766	0,0000000115
GENOVA	0,20252389	0,06848374	0,00290861	0,15516175	0,0000000077
MESSINA	0,36263602	0,20268644	0,06896119	0,20649756	0,0000000267
MILANO	0,20276154	0,03612663	0,00103047	1	0,0000000013
NAPOLI	0,2380422	0,4851581	0,00059399	0,03206635	0,0000010445

PALERMO	0,62507762	0,20176376	0,00223666	0,11707629	0,0000000045
REGGIO C.	0,45740586	0,23935971	0,0389211	0,01799563	0,1415321
ROMA	0,15518559	0,14767766	1	0,02649933	0,0000000048
TORINO	0,26918387	0,1832009	0,01255041	0,10766437	1
VENEZIA	0,13992502	0,89867669	0,00224499	0,15457438	0,0000000097

Table 7. Input-oriented CCR result year 2020

DMU	Institutional, general, and management services	Education	Sustainable development and protection of territory the environment	Trasportation	Policies for employment and vocational training
	Efficiency score	Efficiency score	Efficiency score	Efficiency score	Efficiency score
BARI	1	0,37992583	0,05515083	0,02562767	0,000000001
BOLOGNA	0,39019793	0,06087814	0,18036437	1	0,0000000422
CAGLIARI	0,29588719	0,20551557	0,25456921	0,20769373	0,0000000414
CATANIA	0,35946662	0,5532995	0,03680275	0,03889129	0,000011409

FI- RENZE	0,25055336	0,15744197	0,79243476	0,00043669	0,0000000109
GE- NOVA	0,20551125	0,0759794	0,02986388	0,04401476	0,000000009
MES- SINA	0,2615724	0,16371212	1	0,08811553	0,0000000321
MI- LANO	0,20043943	0,04378922	0,01208847	0,00734626	1
NAPOLI	0,2260953	0,39244616	0,00720921	0,00864594	0,0000000767
PA- LERMO	0,54514329	0,15396093	0,02451162	0,02260723	0,0000000015
REGGIO C.	0,4027718	0,69420497	0,20583857	0,14973752	0,14581901
ROMA	0,16891151	0,13517708	0,0099215	0,01333067	0,0000000062
TORINO	0,28070721	0,16465849	0,1452491	0,03519559	0,0000000054
VENE- ZIA	0,131175	1	0,02439472	0,06226633	0,0000000095

Tabella 8. Input-oriented CCR risultati anno 2021

DMU	Institutional, general, and management	Education	Sustainable development and protection of territory the	Trasportation	Policies for employment and vocational
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	services		environment		training
	Efficiency score	Efficiency score	Efficiency score	Efficiency score	Efficiency score
BARI	0,0489321	0,37992583	0,05515083	0,02562767	0,000000001
BOLOGNA	0,08689878	0,06087814	0,18036437	0,01333067	0,0000000422
CAGLIARI	0,13604411	0,20551557	0,25456921	0,20769373	0,0000000414
CATANIA	0,03501419	0,5532995	1	0,03889129	0,000011409
FIRENZE	0,03156262	0,15744197	0,79243476	0,00043669	0,0000000109
GENOVA	1	0,0759794	0,02986388	0,04401476	0,000000009
MESSINA	0,0555233	0,16371212	0,03680275	0,08811553	0,0000000321
MILANO	0,02717371	0,04378922	0,01208847	0,00734626	0,0000000015
NAPOLI	0,03210405	1	0,00720921	0,00864594	0,0000000767
PALERMO	0,03160403	0,15396093	0,02451162	0,02260723	0,0000000062
REGGIO C.	0,04865577	0,69420497	0,20583857	0,14973752	0,14581901
ROMA	0,02285353	0,13517708	0,0099215	1	1

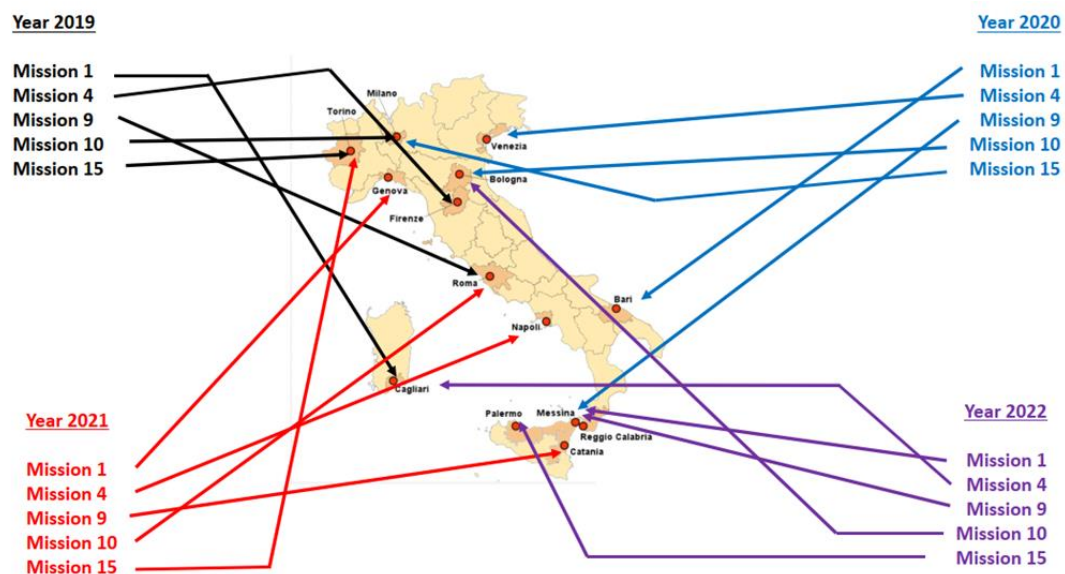
TORINO	0,03726819	0,16465849	0,1452491	0,03519559	0,0000000054
VENEZIA	0,01777375	0,39244616	0,02439472	0,06226633	0,0000000095

Table 9. Input-oriented CCR results year 2022

DMU	Institutional, general, and management services	Education	Sustainable development and protection of territory the environment	Trasportation	Policies for employment and vocational training
	Efficiency score	Efficiency score	Efficiency score	Efficiency score	Efficiency score
BARI	0,00140585	0,08353536	0 ,0000000011	0,1954077	0,0000000302
BOLOGNA	0,00127039	0,10247212	0 ,000000104	1	0,0000000216
CAGLIARI	0,00173617	1	0 ,0000000048	0,38817756	0,0000001672
CATANIA	0,00446608	0,66405245	0 ,0000000401	0,81645857	0,0000001104
FIRENZE	0,00128766	0,04101351	0 ,0000000127	0,00098853	0,0000000239
GENOVA	0,00519933	0,17921647	0 ,0000000106	0,12181638	0,0000001858
MESSINA	1	0,26749501	1	0,31008418	0,71304366
MILANO	0,00548159	0,44823716	0,00000001	0,57534728	0,0000000041

NAPOLI	0,01670491	0,09252843	0,0000000008	0,07007365	0,0000000126
PALERMO	0,00371363	0,08546935	0,0000000067	0,09700699	1
REGGIO C.	0,00355448	0,29974576	0,0000000044	0,35596645	0,46004178
ROMA	0,00326899	0,0964699	0,0000000047	0,44264645	0,0000000029
TORINO	0,00519654	0,38682686	0,0000000657	0,74670399	0,0000000736
VENEZIA	0,00296502	0,07615108	0,0000001079	0,14998011	0,0000001832

Figure 1. Georeferencing of the budget missions of metropolitan cities in Italy



Source: own illustration

Legend: Mission 1: Institutional, general, and management services, Mission 4: Education, Mission 9: Sustainable development and protection of territory the environment, Mission 10: Transportation.

The tables presented above (from Table 6 to Table 9) display the efficiency scores for each mission in every metropolitan city for the years under analysis, as derived from the proposed analysis model. These results offer an initial indication of which Decision-Making Units (DMUs) are operating efficiently. By examining the scores across different missions and years, it becomes possible to identify which cities are performing optimally and

which may require further attention to improve their efficiency in managing public resources and delivering services.

Specifically, for the year 2019, within the "*General services*" mission, the efficiency threshold is reached by the metropolitan city of Cagliari; for the "*Education*" mission, efficiency is achieved by the city of Florence; for the "*Development and land protection*" mission, efficiency is reached by Rome, for the "*Transportation*" mission, by Milan, and for the "*Employment policies*" mission, by Turin.

In detail, for the year 2020, within the "*General services*" mission, the efficiency threshold is reached by the metropolitan city of Bari; for the "*Education*" mission, efficiency is achieved by the city of Venice; for the "*Development and land protection*" mission, efficiency is reached by Messina, for the "*Transportation*" mission, by Bologna, and for the "*Employment policies*" mission, by Milan.

In detail, for the year 2021, within the "*General services*" mission, the efficiency threshold is reached by the metropolitan city of Genoa; for the "*Education*" mission, efficiency is achieved by the city of Naples; for the "*Development and land protection*" mission, efficiency is reached by Catania, for the "*Transportation*" mission, by Rome, and for the "*Employment policies*" mission, by Turin.

In detail, for the year 2022, within the "*General services*" mission, the efficiency threshold is reached by the metropolitan city of Messina; for the "*Education*" mission, efficiency is achieved by the city of Cagliari; for the "*Development and land protection*" mission, efficiency is reached by Messina, for the "*Transportation*" mission, by Bologna, and for the "*Employment policies*" mission, by Palermo.

The results indicate that overall spending in metropolitan cities increased between 2019 and 2022. The total expenditure for the period between 2021 and 2022 rose by approximately 132 million euros in absolute terms, with corresponding increases in payments made. This trend is primarily driven by current expenditures, which accounted for over two-thirds of the total in 2021.

The spending increases show a relatively consistent pattern across different areas, with the most notable rises observed in the metropolitan cities of Sicily. Specifically, Catania saw an increase of +23.9%, Messina rose by +19.3%, and Palermo increased by +17.6%. Florence also recorded a significant increase of +10.3%. In contrast, Rome experienced almost no change in expenditure levels from 2020 to 2022. Turin, however, exhibited a sharp decrease in 2022 compared to the previous year, with current commitments falling by approximately 10 percentage points.

It can be concluded that no metropolitan city reported a negative competence result in 2021. The 14 metropolitan cities collectively allocated resources amounting to approximately 119.8 million euros, while the total earmarked resources in the budget were approximately 498.5 million euros, derived from both current management and capital management. Regarding budget balance, only one metropolitan city, Messina, reported a deficit in 2021. However, for the overall balance, two cities were in deficit: Messina and Milan. These findings highlight the financial challenges faced by certain metropolitan areas, particularly in terms of balancing their budgets and managing expenditures.

In the fiscal year 2021, all entities had closed with a positive balance, presenting an increase, albeit minimal, compared to that recorded in 2020. In the metropolitan cities, the trend of current revenues is not uniform throughout the territory. The trends of own and derived revenues from the current portion still appear unstable. In the biennium 2021-2022, the overall expenditure of metropolitan cities is increasing, particularly noticeable is the "lively" upward trend in current expenses, which account for over two-thirds of the total expenditure.

It is therefore possible to conclude by affirming the positive increase in the accounting result of the administration of metropolitan cities. (lett. A, D.lgs n. 118/2011).

Therefore, it is essential to recognize the importance of refining and correcting the analysis of spending efficiency from a performance management perspective. Reporting the results for the Decision-Making Units (DMUs) under analysis allows for a detailed observation of the factors that hinder the achievement of optimal efficiency thresholds. This makes the efficiency score a crucial tool for analyzing, controlling, and reporting on the complex phenomena that influence the governance of public spending. By treating DMUs as units that produce public value, the efficiency score offers valuable insights for improving resource allocation, enhancing service delivery, and ultimately achieving greater public sector effectiveness.

In response to the growing need for the rationalization of public spending dynamics, the analysis conducted can serve as a valuable tool for monitoring public spending. It enables targeted interventions that aim to consolidate cost containment and requalification efforts, ensuring alignment with the objectives of public expenditure.

When implemented thoughtfully, the efficiency score becomes not only a tool for evaluation but also a succinct source of information that supports decision-making bodies. This is particularly crucial within the context of the public value creation process. The efficient use of resources (inputs) to produce not only goods and services (outputs) but also meaningful outcomes require robust tools to measure the impact on citizens and businesses. For example, it becomes vital to assess the extent to which a service meets the concrete needs of its recipients. In conclusion, spending should be analyzed in relation to the effects it generates. This approach allows for the identification of service management levers, especially in areas where efficiency scores are unsatisfactory, guiding necessary improvements to ensure that public spending effectively enhances public value.

The identification of objectives or quantitative targets is essential for translating abstract strategic goals into measurable outcomes. This step is critical because the establishment of clear, quantitative objectives—based on transparent and monitorable indicators—provides a foundation for enhancing the performance of public administrations. Furthermore, when these indicators are made accessible for ex-post evaluation by citizens, they contribute to greater accountability and enable continuous improvements. This scalability factor, rooted in measurable and observable goals, fosters a culture of performance management that aligns public sector efforts with tangible, citizen-centric results.

CONCLUSIONS

The issue of expenditure efficiency within public administrations has consistently been a topic of discussion in the economic-business scientific debate, as well as in the formulation of laws that have emerged over time in Italy. This dynamism highlights how the assessment of public spending efficiency, at all levels, remains at the center of political and academic discourse, proving to be perpetually relevant. This study analyzed the efficiency of expenditure in Italian metropolitan cities, a sample that remains relatively unexplored in the literature, with particular reference to the specific functions of the Budget for the period 2019-2022. Data concerning local spending were extracted from the budgets, focusing on the following missions: "Institutional, general, and management services," "Education," "Transport," "Sustainable development and protection of territory and environment," "Employment policies and professional training" (Florano, 2020).

Once the inputs and outputs for the identified missions were selected, a Data Envelopment Analysis (DEA) was conducted for each mission and for each year. The application of this analytical model allowed for data processing and the generation of comparative information on metropolitan cities to critically understand their functioning in relation to the panel of services based on spending data for each mission.

The results not only provide a qualitative indication of the efficiency of individual Decision-Making Units (DMUs), but also, through the target input values that inefficient DMUs must strive for to approach the efficiency frontier, represent a clear quantitative indication of how much the performance of the DMUs can be improved. This indication represents a goal of real "value" in terms of performance, and since the nature of target values is objective, it constitutes an achievable outcome in terms of planning and programming DMU activities.

The study aims to serve as a preliminary outcome that, through appropriate refinements, could be tested in other local administrations following a cross-sectional logic, which, as known, can provide greater rigor compared to the results obtained. Furthermore, this work has allowed for testing the limits of the DEA model concerning semi-complex variables. As suggested in the related literature, to test the robustness and confidence in the results obtained, it might be important, for example, to compare the results with other models and methodologies, such as Stochastic Frontier Analysis. This would further enhance the efficiency analysis perspectives regarding both input- and output-oriented models. In conclusion, it would be beneficial to extend the study through the development and application of efficiency scores for overall spending (Afonso and Fernandes, 2008; Agasisti and Porcelli, 2022).

Despite the limitations of the document, the results of the conducted analysis provide a set of information that allows for an understanding of the factors influencing performance outcomes in terms of allocation and utilization of economic and financial resources. This could represent a new evaluation metric for decision-makers in the context of a more accurate attribution of the strategic objectives of the PIAO. The plan also emphasizes the importance of accelerating service delivery, aiming to improve not only speed but also the quantity and quality of services provided. This approach translates into a more responsive and efficient public administration, capable of better responding to the needs of the community, thereby contributing to an increase in the overall well-being of citizens and businesses. The PIAO is an ambitious reform initiative aimed at modernizing the

Italian public administration, making it more flexible, innovative, and value-oriented, with a positive impact on the quality of life and the competitiveness of the national economic system (Deidda Gagliardo and Saporito, 2021).

This reflection is also the result of recent regulations on expenditure revisions, as well as the planning of National Recovery and Resilience Plan (PNRR) resources. In both cases, it is necessary to implement a path for improving the effectiveness and efficiency of public spending through the analysis and evaluation of the decision-making and implementation processes of the involved Public Administrations, with particular attention to state, regional, and municipal organizational structures. The pragmatism of the issue highlights the importance of such analysis processes, which would require greater real-world application to overcome the limits of theoretical applications. Local administrations, consequently, representing a significant part of public organizations, deserve particular attention regarding the possibility of introducing tools aimed at improving the efficiency of public spending choices. Regardless of various specifics, efficiency fundamentally implies minimizing costs in the provision of services. Promoting a cultural growth of efficiency would mean being drivers of optimal resource use relative to what is necessary to meet the demands of citizens/users. The challenge in creating public value lies in using measures of efficiency, effectiveness, and economy to have a positive impact on communities, territories, citizens, and thus improve the level of well-being (Benvenuto, et al., 2023).

The relevance of the Italian context emerges as a key element for a deep understanding of the scientific objectives of this study. Italian metropolitan areas, characterized by marked regional inequalities and complex administrative challenges, present a fertile ground for a critical analysis of efficiency in public spending. The stratification of the Italian bureaucracy, combined with recent reforms, including those outlined in the PIAO, underscores the urgency of optimizing resource allocation. This study aims not only to enrich the academic debate but also to provide practical guidelines for tangible improvements in public policies, supporting a more fruitful use of economic and financial resources.

This reflection also arises from recent regulations concerning expenditure reviews and the planning of resources within the National Recovery and Resilience Plan (PNRR). In this context, it is imperative to initiate a journey of refining the effectiveness and efficiency of public spending through meticulous analysis and evaluation of the decision-making and implementation procedures of the involved Public Administrations. Special attention should be paid to organizational structures at the state, regional, and municipal levels. The pragmatism of the issue highlights the importance of such analytical processes, which require concrete application to overcome the limitations of the theories elaborated so far. Local administrations, in summary, represent a fundamental component of public organizations and deserve specific attention regarding the introduction of tools aimed at improving the efficiency of public spending choices.

Regardless of the multiple specifics, efficiency, in essence, implies the minimization of costs in the production of services to be delivered. Promoting a cultural growth of efficiency means becoming drivers of optimal resource use, calibrated to meet the needs of citizens and users. The challenge in creating public value lies in the ability to employ

measures of efficiency, effectiveness, and economy, with the goal of generating a positive impact on communities, territories, and citizens, thereby contributing to an enhancement of collective well-being.

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