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Impact of regional investment on the sustainable development goals: A group analysis of economic and territorial development

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Abstract

The European Green Deal aims at increasing the sustainability of European economic sectors to mitigate the effects of climate change. Complementing this initiative, the Next Generation EU (NGEU) program, whose budget will exceed 800 billion € by 2026, is not merely a recovery plan but also a catalyst for green technologies and sustainable activities. Within this framework, Italy stands as the largest beneficiary of funds. The present study explored the distribution to date of 194.4 billion € NGEU funds across Italian regions and the Sustainable Development Goals (SDGs) that have received the most significant attention as a result of this funding. Leveraging multiple comprehensive datasets, including one encompassing more than 306,706 measures and sub-measures, the analysis revealed that 55.5 billion € was directed towards Italy's "Green Revolution and Ecological Transition," with a further 104.1 billion € allocated towards (predominantly) SDGs 7 and 9. Moreover, 70.3 billion € was directed towards southern Italy (including the islands), while 81.0 billion € was allocated to the north. Although the population in the north is approximately one-third larger than that of the south, on a per capita basis, the north received 2930 € while the south received a significantly greater sum of 3470 €. Thus, the NGEU has not significantly reduced the north–south divide in economic terms. Furthermore, some southern regions have shown satisfactory sustainability performance, despite receiving a relatively lower allocation of NGEU funds. The "Made in Italy" initiative may represent a strategic approach to increasing competitiveness in the global and digital markets and fostering fraternity among Italian regions. The present research offers valuable insights into the regional distribution of funds and their impact on sustainable development, suggesting that territorial gaps may be mitigated through a pragmatic, community-based approach.

KEYWORDS
investments, Italy, policy implications, regional analysis, sustainability

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1 | INTRODUCTION

The Sustainable Development Goals (SDGs) have become a central component of the global agenda (Mishra et al., 2023). Since their inception, notable environmental and social improvements have been observed (Ordonez-Ponce, 2023), as well as policy shifts across numerous countries (Guang-Wen et al., 2023; Kostetckaia & Hametner, 2022). However, several critical aspects remain inadequately addressed (Giannetti et al., 2020; Yamaguchi et al., 2023). Pragmatic approaches to sustainability must be based on comprehensive analyses of sustainability across all of its three dimensions (i.e., economic, environmental, social), including ex-ante spatial impact assessments that transcend singular ideological perspectives. Such analyses may support the development of a more humane and united Europe with the potential to not only pursue ambitious sustainability goals, but also contribute to geopolitical stability (D'Adamo, Di Carlo, Gastaldi, & Uricchio, 2024). Economic prosperity aligns with the SDGs when growth is inclusive and equitable (Cook & Davíðsdóttir, 2021). Within Europe, northern and western countries typically demonstrate superior sustainability performance, whereas nations from the former Soviet bloc and the Mediterranean region exhibit comparatively lower outcomes (Ricciolini et al., 2024).

The European Green Deal (EGD) was designed to make European economic sectors more sustainable, in an effort to combat climate change. However, scholars have highlighted persistent challenges in environmental sustainability planning (Hereu-Morales et al., 2024). Moreover, analyses have indicated that, while the EGD aligns well with SDGs 7, 12, and 13, it inadequately addresses SDGs 1, 2, 3, 4, 5, 8, 10, and 16 (Koundouri et al., 2024). The Next Generation EU (NGEU) initiative extends beyond a mere recovery plan, with a budget that will surpass 800 billion € (equivalent to 750 billion € in 2018 prices) by 2026. This package includes significant investment in green technologies and sustainability-related activities (Aydin & Degirmenci, 2024). The post-pandemic era is anticipated to bring about sustainable transformations that could influence other global powers, such as China—potentially fostering long-term cooperation in green and digital economies (Zhao et al., 2023)—and the United States, which is expected to increase investment in green energy and energy efficiency (Liu et al., 2023).

To date, Italy has received the largest amount of NGEU funding. As highlighted in the literature, the availability of extensive data may facilitate the development of an integrated approach to evaluating current spatial policies and proposing future directions (Cohen, 2017). Additionally, sustainability indicators may be used to monitor the progress of national recovery and resilience plans (NRRP). Italy, as a member of the G7, appears committed to assessing the trajectory of SDG-related growth (Puertas & Marti, 2023; Richiedei & Pezzagno, 2022).

Indicators of equitable and sustainable well-being reveal significant regional disparities within Italy, with northern regions significantly outperforming their southern counterparts. Meanwhile, central regions are showing a positive trend, gradually narrowing the gap with northern regions (D'Adamo, Di Carlo, Gastaldi, Rossi, & Uricchio, 2024). A comparative analysis of these indicators with the SDGs indicated that the northeast—and particularly Trentino-Alto Adige and Friuli-Venezia Giulia—performs exceptionally well. However, there is a slight performance gap between the northwest (with Valle d'Aosta playing an important role) and the central regions (in which Toscana stands out). Additionally, regions such as Emilia-Romagna, Lombardia, and Veneto excel in two of the three dimensions of sustainability, while Umbria, Lazio, and Abruzzo (the only southern region) demonstrate excellence in only one dimension (D'Adamo et al., 2024a). The literature highlights the importance of investigating the potential relationships between Italy's NRRP and the SDGs (Perchinunno et al., 2023), emphasizing the necessity of ongoing monitoring (D'Adamo & Gastaldi, 2023).

The present study aimed at analyzing the allocation of NGEU funds at the regional level in Italy, utilizing open data provided by the Italian government, to identify which SDGs have received the most attention, thereby offering insights into the distribution of these funds and their impact on sustainability, to inform future policy development. In this regard, group analyses were proposed to support policy-makers and engage stakeholders across all sectors, with a particular focus on the economic dimension. This focus was critical for assessing the relationship between the distribution of funds and current sustainability performance at the regional level, to support economic and territorial development.

The structure of the paper is as follows: Section 2 provides a literature review, while Section 3 describes the methodology. Section 4 presents the results, and Section 5 discusses the potential policy implications. Finally, Section 6 presents the conclusions of the work.

2 | LITERATURE REVIEW

The NGEU is the comprehensive policy framework of the EU, devised not only to address the economic crisis generated by the COVID-19 pandemic, but also to respond to the austerity measures implemented following the 2008 financial crisis. As a result of these two events, several distinct coalitions emerged: the formidable "frugal" countries; the Germany-France alliance, which was instrumental in shaping the NGEU; the Polish-Hungarian axis, presenting considerable challenges; and the Italian-Spanish front, necessitating substantial financial grants (de la Porte & Jensen, 2021).

The NGEU was proposed as a highly innovative mechanism (Schelkle, 2021) to support reforms in countries with limited fiscal capacity and therefore fewer opportunities for welfare initiatives (Corti & Vesan, 2023). Thus, attention was given to solidarity (Ferrera et al., 2021) and, particularly within the context of technological transformation, the development of human capital to manage emerging social risks (Petmesidou et al., 2023). Several studies have highlighted the significance of a human-centered artificial intelligence approach (Martini et al., 2024), aimed at fostering business agility (Fernández-Miguel et al., 2024a) and promoting sustainable supply chains (Tavana, 2023) through comprehensive life-cycle analyses (Basile et al., 2024). Furthermore, young Europeans have highlighted that the

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NGEU transcends youth-specific issues, addressing broader concerns such as climate change and poverty (Krzaklewska et al., 2023), thereby underscoring the urgent need for the development of sustainable communities (Berezvai et al., 2024; Corazza et al., 2024). Importantly, resilience and adaptability at the local level are fundamental to effectively countering change at the global level (Fernández-Miguel et al., 2024b).

Despite this positive initiative, Europe remains divided on the issue of fiscal risk sharing, with divergent views emerging between the north and south (Miró, 2022). Some scholars have argued that the NGEU has prompted a shift towards an expansion-oriented approach, moving away from the austerity approach that characterized previous policies (Armingeon et al., 2022). However, economic governance within the EU remains in a state of flux, with ongoing debate over potential revisions to the Stability and Growth Pact (Crespy et al., 2024). The challenge presented by the NGEU is significant and it may indeed serve as a turning point. However, three major contingencies must still be addressed: (i) the effective utilization of all resources, (ii) the coordination of policies, and (iii) the implementation of national reforms irrespective of election cycles (Buti & Fabbrini, 2023). Thus, the success and efficacy of the NGEU may hinge on streamlined implementation procedures and a territorial orientation that could potentially diminish the role played by regional authorities (Crescenzi et al., 2021). While this could reduce delays, it may also compromise the concept of sustainable communities. The pandemic necessitated a re-evaluation of intergovernmental relations in the provision of social services (Lippi & Terlizzi, 2023). In addition, challenges such as emerging bottlenecks, inflationary pressures, and a shortage of skilled labor could diminish the plan's overall positive impact (Fernández-Cerezo et al., 2024).

Italy represents an exemplary case study in this context, being both the largest beneficiary of NGEU funds and a country notorious for its delayed implementation of European directives and spending of public funds (Di Mascio et al., 2024). Specifically, Italy has requested the largest share of loans, exceeding the amount of grants received. The NRRP, which also includes RePowerEU, has a budget of 194.4 billion €, of which 71.8 billion € is in grants and 122.6 billion € in loans. This Plan encompasses 620 goals and objectives, 66 reforms, and 150 investments, with the greatest impact observed on SDGs 9, 13, and 7 (Cavalli et al., 2023). Moreover, the composition of governing parties is crucial for explaining the shifting interests of policy-making interest groups (Pritoni et al., 2023). However, where administrative capacity is lacking, hindering the initiation of some reforms (Di Mascio & Natalini, 2023), it becomes imperative to implement changes to the NRRP.

On April 26, 2024, the European Commission approved Italy's request for a targeted revision of its NRRP. Subsequently, on August 5, 2024, the European Commission disbursed the fifth installment of the NRRP to Italy, amounting to 11 billion €. This payment further solidified Italy's position as the member state receiving the largest amount of funding under the Plan, with a cumulative total of 113.5 billion € (corresponding to 58.4% of the Plan's total resources). Positively, the Italian National Institute of Statistics (ISTAT) recently reported encouraging economic indicators estimating a 0.7% growth in gross domestic product (GDP) for the first half of 2024.

Several scholars have highlighted the strategic alignment between the SDGs and the NRRP (Perchinunno et al., 2023). Indeed, the relationship between SDG indicators and policy outcomes is crucial for monitoring performance and implementing corrective actions (D'Adamo et al., 2022; Raimo et al., 2024). To support this aim, analytical methodologies integrating diverse datasets are needed to compare performance across countries and identify potential clusters (D'Adamo et al., 2024a). Within this strategic framework, the "Made in Italy" initiative has been identified as a key driver of national competitiveness. This branding program, based on Italy's widespread association with beautiful, sophisticated, and authentic products (Matarazzo et al., 2021), applies to multiple sectors of the economy (Baralla et al., 2021; Carbone & Henke, 2023; Pomarici et al., 2021) and extends beyond the mere use of local raw materials to also include a high degree of professionalism and craftsmanship (Matarazzo et al., 2024). However, to maximize its success, stakeholder engagement is needed, especially given the significant role played by small and medium-sized enterprises in the Italian economy (Giordino et al., 2024).

3 | METHODOLOGY

This section describes the reference dataset (Section 3.1) and data aggregation (Section 3.2). Following this, a methodological framework is constructed in which the data are disaggregated by mission, SDG, and region (Section 3.3).

3.1 | Dataset

To analyze the distribution of total NRRP funding across Italian regions and its alignment with the SDGs, a series of open datasets were analyzed from the Italia Domani (2024) platform. Of note, all datasets were accessed between August 3 and 6, 2024, ensuring that the results reflect the most current data available at the time. Consequently, the results are specific to the date on which the projects were reported. The following datasets were utilized:

1. *Location of NRRP Projects—ReGiS Universe* (observation date: July 25, 2024)

This dataset associates each project with specific locations across Italy using CUP/CLP codes extracted from the ReGiS platform. It includes information such as region, province, municipality, address, and postal code. Of note, a single CUP may appear multiple times if the project spans multiple locations (e.g., large-scale infrastructure projects, such as railways). The dataset encompasses all CUP/CLP codes, regardless of their submission status or validation process outcome (with the latter referring to periodic data verification and administrative checks by the implementing entities).

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2. *NRRP Projects—ReGiS Universe* (observation date: July 25, 2024)

This dataset provides detailed information for each measure or sub-measure of the NRRP, as identified using CUP/CLP codes. It includes activation procedures, CUP status, nature, type, sector, subsector, category, title, summary, total funding (broken down by source), implementing entity, project status, and scheduled and actual start and end dates.

3. *Financial Framework of the NRRP* (observation date: July 25, 2024)

This dataset contains detailed descriptions and identifying codes for each measure and sub-measure, including mission and component codes. It also includes financial details such as the amount of funding, type of investment (loan or grant), and other specifics outlined in the EU Council's implementing decision (ST 16051/23; ST 16051/2023 ADD 1) from December 8, 2023, which revised the initial decision of July 13, 2021 (ST 10160/21; ST 10160/21 ADD 1 REV 2). The dataset also specifies the responsible administrative bodies and the allocated amounts for both ongoing and new projects, as outlined in the Decree of the Minister of Economy on May 3, 2024.

4. *Monitoring NRRP Measures through the SDGs and Agenda 2030* (observation date: June 19, 2024)

This dataset provides a comprehensive overview of the monitoring framework established for the NRRP measures and sub-measures, accompanied by statistical indicators for well-being and sustainability. It includes a complete mapping of NRRP measures and sub-measures to the SDGs of the 2030 Agenda, developed collaboratively through ISTAT, the Ministry of Economy and Finance, and the General Accounting Office of the State.

These datasets were instrumental for the regional analyses of the allocation and use of NRRP funds in Italy to achieve the SDGs.

3.2 | Data aggregation and visualization

Given the extensive *NRRP Projects—ReGiS Universe* dataset, comprising 306,706 measures and sub-measures, both Excel and R were used for the data analysis and visualization. In more detail, the volume and complexity of the data necessitated the use of R for efficient data handling, analysis, and visualization. This use of statistical software such as R is well-established in the social sciences (Shepherd & Richardson, 2024), and its application is increasingly critical in our digitized global environment, across disciplines (Lasser et al., 2021). For each mission, we examined the number of measures and sub-measures and calculated the total allocated funding. The missions may be described as follows:

1. Mission 1—*Digitalization, Innovation, Competitiveness, Culture, and Tourism*

This mission focuses on advancing digital transformation and innovation across sectors, enhancing the competitiveness of Italian businesses and supporting the cultural and tourism sectors. It includes initiatives to improve digital infrastructure, foster technological advancements, and promote Italy's rich cultural heritage and tourism industry.

2. Mission 2—*Green Revolution and Ecological Transition*

This mission is dedicated to advancing environmental sustainability and mitigating climate change. It aims at fostering the development of a green economy through various measures, including the expansion of renewable energy usage, the enhancement of energy efficiency, and the reduction of carbon emissions. It also encompasses initiatives aimed at the preservation of natural resources and biodiversity.

3. Mission 3—*Infrastructure for Sustainable Mobility*

This mission focuses on the development of sustainable transportation infrastructure. It prioritizes investment in public transportation systems, rail networks, and other infrastructure projects that promote environmentally friendly and efficient mobility solutions, aimed at reducing traffic congestion and pollution.

4. Mission 4—*Education and Research*

This mission aims at enhancing the education system and fostering research and innovation. It includes initiatives to improve educational facilities, support scientific research, and enhance the quality and accessibility of education at all levels. The ultimate objective is to strengthen Italy's knowledge economy and develop a skilled workforce for the future.

5. Mission 5—*Cohesion and Inclusion*

This mission emphasizes social cohesion and inclusion. It seeks to address disparities and inequalities by providing support to vulnerable groups, promoting social and economic inclusion, and improving the quality of public services. Initiatives under this mission aim at enhancing social welfare, reducing regional disparities, and ensuring equal opportunities for all citizens.

6. Mission 6—*health*

This mission aims at improving the healthcare system and public health outcomes. It includes investments in healthcare infrastructure, medical research, and the digitalization of health services. The primary goal is to enhance the quality and accessibility of healthcare, promote preventive care, and ensure the resilience of the healthcare system.

7. Mission 7—*RePowerEU*

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This mission aligns with the broader EU initiative aimed at reducing dependency on fossil fuels and accelerating the transition to renewable energy sources. It focuses on enhancing energy security, increasing the use of renewable energy, and fostering energy efficiency. The overall goal is to support Europe's pursuit of energy independence and sustainability, particularly in response to ongoing global energy challenges.

3.3 | Methodological framework

The present study employed a robust methodological framework based on the collection and aggregation of extensive data. The data analysis and graph creation were conducted using the programming language R. Additionally, Excel and PowerBI were utilized for supplementary data manipulation and visualization tasks. The chosen framework aligned with the research objectives, which did not seek to compare the performance or efficiency of different regions, but to analyze a public dataset concerning an economic plan, to highlight critical issues and uncover insights and potential policy implications.

The total funding for each mission was presented using bar charts, providing a clear visual comparison. Additionally, funding allocations were mapped to the relevant SDGs, illustrating the alignment of the NRRP with these global objectives.

For the regional analysis, we aggregated the total funding for each Italian region and categorized the regions into broader geographic zones: northeast, northwest, central, south, and the islands. To enable a more accurate comparison of the regional funding distribution, we normalized the data on a per capita basis, reflecting population size. Further analysis was conducted to examine how the funding in each region addressed various SDGs, highlighting regional priorities and focus areas within the NRRP.

To provide a comprehensive understanding of the geographical and thematic distribution of NRRP funds, we present two maps of Italy: one illustrating the regional allocation of NRRP funds in absolute terms and another showing the per capita allocation. These visual tools help to elucidate the contributions of NRPP funds to the SDGs across Italy.

4 | RESULTS

This section delineates the allocation of the 194.44 billion € of NRRP funds in Italy. Initially, the funds are analyzed according to mission (Section 4.1) and SDG (Section 4.2). The national totals are then disaggregated by region (Section 4.3) and further broken down by SDG (Section 4.4). Subsequently, the data are aggregated by geographic macro area (Section 4.5). Finally, to facilitate a homogeneous comparison across regions, the data are evaluated on a per capita basis (Section 4.6). The findings from this analysis are then further examined to identify the prioritization of certain SDGs and provide a comparison with sustainability rankings (Section 4.7).

4.1 | Allocation of NRRP funds by mission

Figure 1 illustrates the distribution of funding among the various missions of the NRRP, as derived from the *Monitoring NRRP Measures through the SDGs and Agenda 2030* dataset. The data revealed significant variations in resource allocation across the seven missions, reflecting the government's prioritization with respect to the Agenda 2030 goals.

Mission 2 received the highest level of funding, totaling approximately 56 billion €. This substantial allocation underscores the priority given to environmental sustainability and the transition towards a green economy, emphasizing the critical importance of ecological initiatives within the NRRP framework. Following closely, Mission 1 was allocated approximately 41 billion €, indicating a strong commitment to advancing digital transformation, fostering innovation, and enhancing Italy's cultural and tourism sectors—essential drivers of competitiveness and economic growth. The allocation of 30 billion € to Mission 4 underscores the government's commitment to strengthening the educational system and bolstering research capabilities. This investment aims at developing human capital and fostering innovation—both crucial for long-term economic resilience. Mission 3 was allocated 24 billion €, focused on the development of sustainable transportation infrastructure. In particular, this funding supported projects aimed at improving public transportation and reducing carbon emissions, aligning with the broader environmental objectives of the NRRP. Mission 5 received approximately 17 billion €, directed towards initiatives to improve social cohesion and inclusion. This funding aimed at addressing regional disparities and promoting equal opportunities, thereby advancing social equity and integration. The allocation of 16 billion € to Mission 6 aimed at enhancing the healthcare system. This included investments in healthcare infrastructure and services to improve public health outcomes and build greater resilience against future health crises. Finally, Mission 7 was allocated the lowest amount of funding, at 11 billion €. This mission aligns with the EU's broader efforts to enhance energy independence and sustainability, focused on increasing the use of renewable energy sources and improving energy efficiency.

4.2 | Allocation of NRRP funds by SDG

The Agenda 2030 dataset revealed a strategic and balanced approach to addressing both immediate and long-term challenges, with a particular emphasis on green and digital transformation, infrastructure development, and social inclusion. Thus, funding initiatives aligned closely with the objectives of the Agenda 2030, aimed at fostering a sustainable and resilient recovery for Italy.

Figure 2 presents the distribution of funds among various SDGs within the NRRP, as derived from the *Monitoring NRRP Measures through the SDGs and Agenda 2030* dataset. The chart reveals significant investment across diverse areas, reflecting a commitment to achieving balanced and sustainable development in Italy.

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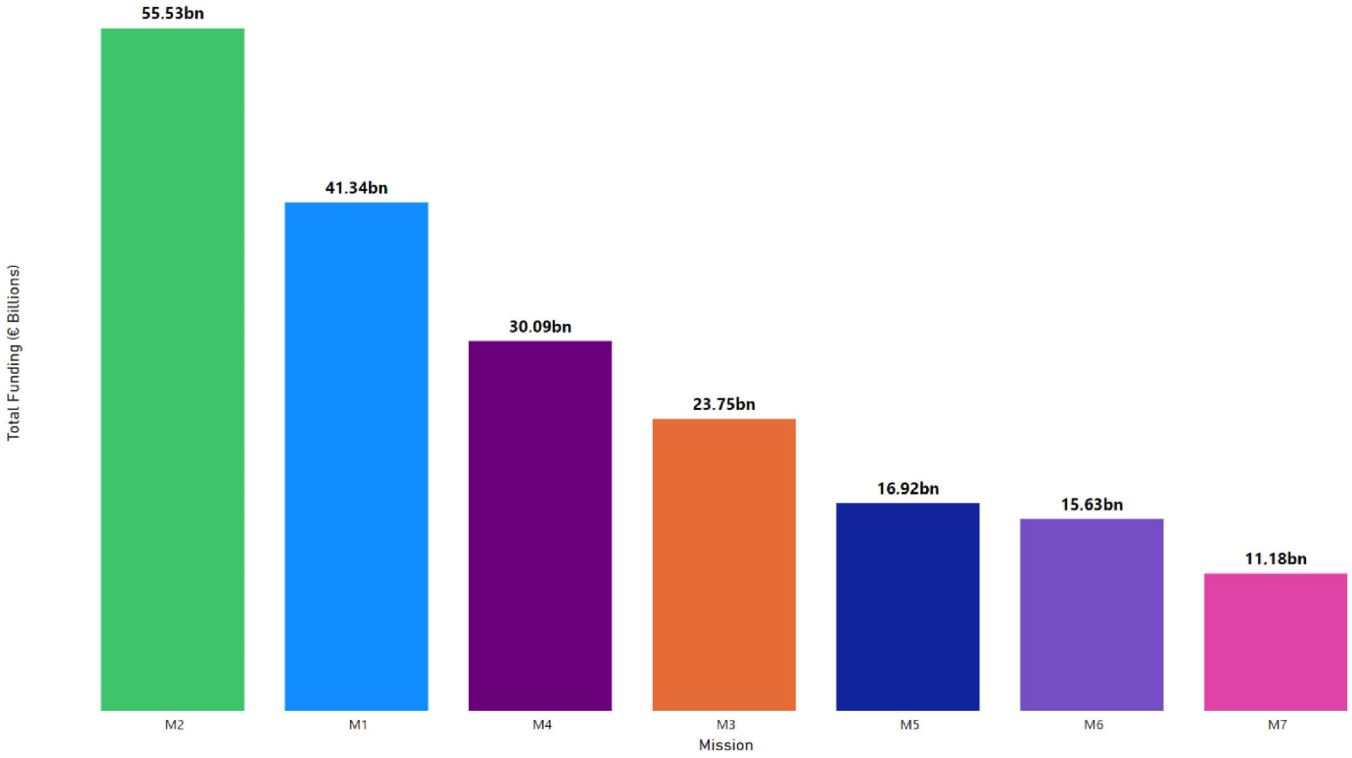

FIGURE 1 Allocation of national recovery and resilience plans funds by mission: M1 (Digitalization, Innovation, Competitiveness, Culture, and Tourism); M2 (Green Revolution and Ecological Transition); M3 (Infrastructure for Sustainable Mobility); M4 (Education and Research); M5 (Cohesion and Inclusion); M6 (Health); and M7 (RePowerEU).

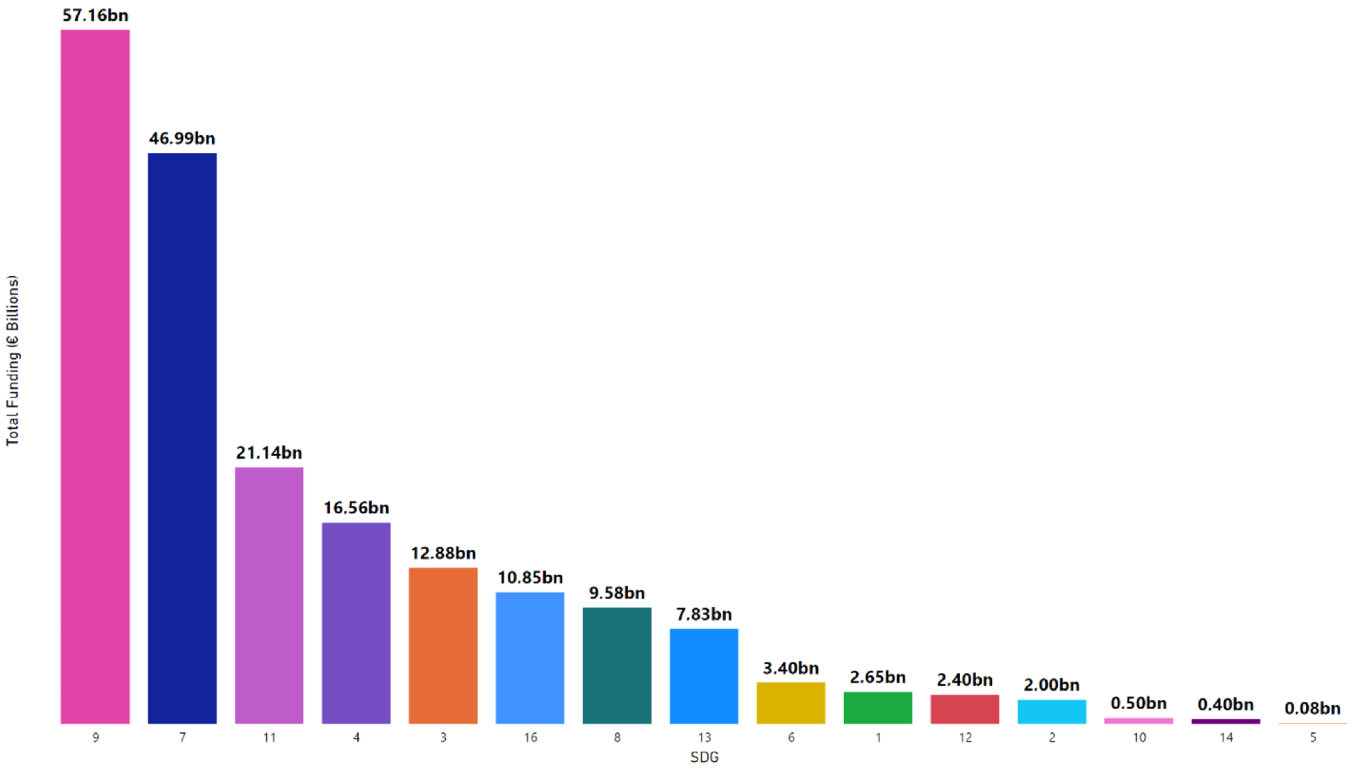

FIGURE 2 Allocation of national recovery and resilience plans funds by Sustainable Development Goals.

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SDG 9 (Industry, Innovation, and Infrastructure) received the largest allocation (57.16 billion €), highlighting the prioritization of resilient infrastructure, inclusive and sustainable industrialization, and innovation. Following closely, SDG 7 (Affordable and Clean Energy) was allocated 46.99 billion €, underscoring the commitment to ensuring access to affordable, reliable, sustainable, and modern energy for all. These two allocations, for SDGs 7 and 9, summed to more than half of the total funding value, reflecting the critical importance of these goals.

SDG 11 (Sustainable Cities and Communities) was allocated 21.14 billion €, suggesting a strategic focus on the creation of inclusive, safe, resilient, and sustainable urban environments. SDG 4 (Quality Education) received 16.56 billion €, supporting initiatives aimed at ensuring inclusive and equitable quality education and lifelong learning opportunities. SDG 3 (Good Health and Well-being) received 12.88 billion €, aimed at ensuring healthy lifestyles and promoting well-being for all ages. SDG 16 (Peace, Justice, and Strong Institutions) received 10.85 billion €, reflecting efforts to foster peaceful and inclusive societies, ensure access to justice, and build effective, accountable institutions. SDG 8 (Decent Work and Economic Growth) received 9.58 billion €, signaling a strong emphasis on the promotion of sustained, inclusive, and sustainable economic growth, alongside full and productive employment and decent work for all. SDG 13 (Climate Action) was allocated 7.83 billion €, underscoring the commitment to taking urgent action to combat climate change and mitigate its impacts.

Smaller sums were allocated to the other SDGs, including SDG 6 (Clean Water and Sanitation), with 3.40 billion €; SDG 1 (No Poverty), with 2.65 billion €; SDG 12 (Responsible Consumption and Production), with 2.40 billion €; SDG 2 (Zero Hunger), with 2 billion €; SDG 10 (Reduced Inequalities), with 0.50 billion €; SDG 14 (Life Below Water), with 0.40 billion €; and SDG 5 (Gender Equality), with 0.08 billion €.

As highlighted in the literature (Costanza et al., 2016; Kettunen et al., 2018), sustainability is often conceptualized as encompassing three interrelated dimensions: economic, environmental, and social. The majority of the funds analyzed here were allocated to the economic dimension, specifically targeting SDGs 7, 9, and 11. The total funding for these three goals amounted to 125.29 billion €, representing approximately 64.44% of the total allocation of 194.42 billion €. This substantial investment underscores the prioritization of economic objectives within the NRRP, with a particular emphasis on building resilient infrastructure, promoting inclusive and sustainable industrialization, and ensuring widespread access to affordable, reliable, sustainable, and modern energy.

4.3 | Regional allocation of NRRP funds

The regional allocation of NRRP funds across Italy, as depicted in Figure 3, was derived by associating each measure or sub-measure, identified using CUP/CLP codes from the *NRRP Projects—ReGiS Universe* dataset, to the corresponding entries in the *Location of NRRP projects—ReGiS Universe* dataset. Figure 3 provides a comprehensive overview of the regional distribution of funds. Of note, the map excludes 11.11 billion € earmarked for projects with national scope, thereby maintaining a focused analysis on the regional allocations.

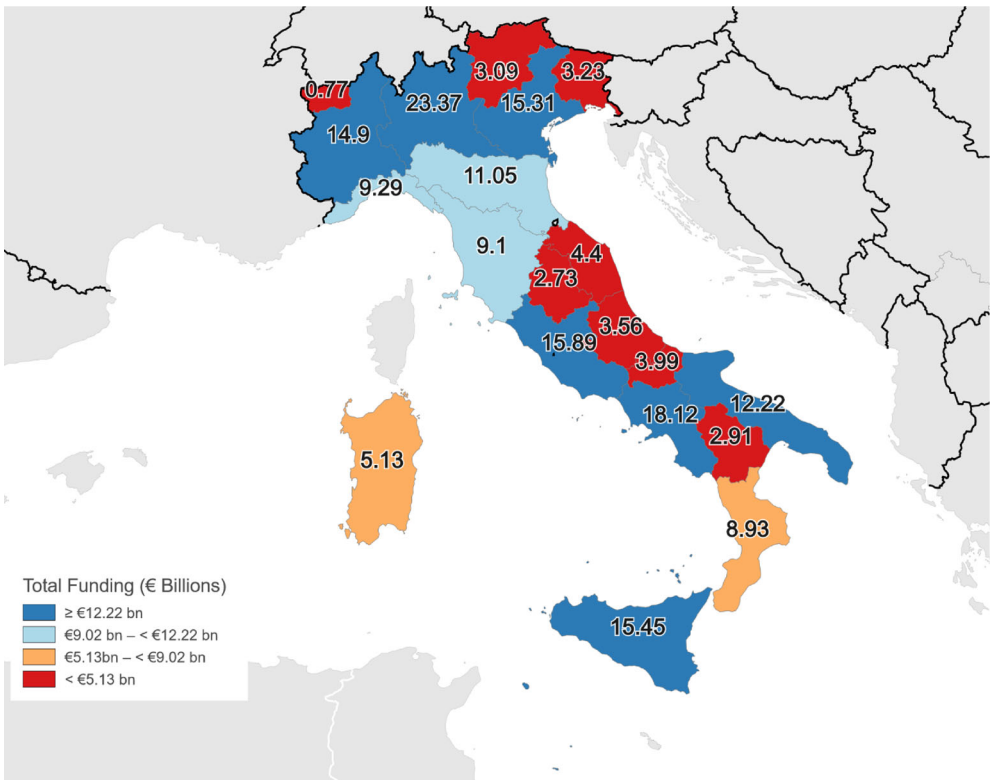

FIGURE 3 Regional allocation of national recovery and resilience plans funds.

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The map reveals substantial disparities in funding across regions. Lombardia, in northern Italy, was the top recipient nationally, with a total allocation of 23.37 billion €. This significant allocation reflects Lombardia's strategic importance and extensive project portfolio within the NRRP framework. Veneto followed with a notable allocation of 15.31 billion €, highlighting its role as a major industrial hub. In contrast, Trentino-Alto Adige and Valle d'Aosta received markedly lower allocations of 3.09 € billion and 0.77 billion €, respectively, indicating a more moderate investment focus on these less populated regions. In central Italy, Lazio led with a significant allocation of 15.89 billion €, underscoring its central role in the nation's economy and infrastructure. Toscana followed with 9.10 billion €, supporting the region's diverse economic activities and infrastructural needs. Conversely, Marche and Umbria received smaller allocations of 4.40 and 2.73 billion €, respectively, correlating with their smaller population sizes. In southern Italy, Campania was the largest recipient, with an allocation of 18.12 billion €, indicating significant investment to address the region's socio-economic challenges. Sicilia also received substantial funding of 15.45 billion €, highlighting a focus on boosting development in this major island region. On the lower end, Abruzzo and Basilicata received 3.56 and 2.91 billion €, respectively.

This regional distribution of NRRP funds demonstrates a targeted approach to addressing regional disparities and promoting balanced development across Italy. By allocating substantial resources to both highly developed and less developed regions, the NRRP aims at fostering inclusive growth and sustainable development nationwide.

4.4 | Regional allocation of NRRP funds by SDG

Following the presentation of the regional allocation of NRRP funds across Italy (Figure 3), we now turn to a more detailed analysis of how these funds were directed towards the SDGs in each region. Figure 4 presents a detailed breakdown of the total funding allocated to each region, segmented by SDG.

In Lombardia, the largest allocations were directed towards SDG 9, which received 8.6 billion € (36.81%), and SDG 7, which received 5.6 billion € (23.96%). Similarly, Veneto assigned 6.7 billion € (43.77%) of investments to SDG 9 and 3.5 billion € (22.86%) to SDG 7. At the lower end of the spectrum, Trentino-Alto Adige directed 1 billion € (32.36%) of its funds to SDG 7 and 0.9 billion € (29.13%) to SDG 9. Valle d'Aosta, despite having the smallest overall funding, emphasized critical areas by dedicating 0.5 billion € (64.94%) towards SDG 9, indicating a targeted approach to enhancing industrial infrastructure.

In central Italy, Lazio directed 4.1 billion € (26.14%) towards SDG 9 and 3.2 billion € (20.38%) towards SDG 11, reflecting a focus on urban development and industrial growth—both of which are crucial for the region's economic development. Toscana, with its total allocation of 9.1 billion €, directed 2.3 billion € (25.27%) towards SDG 9, 2.1 billion € (23.08%) towards SDG 7, and 1.9 billion € (20.88%) towards SDG 11, reflecting a diversified approach. Conversely, Marche and Umbria, despite receiving less overall funding, strategically prioritized their allocations. Marche directed 1.4 billion € (31.82%) of its total 4.4 billion € towards SDG 9, and 1.1 billion € (25%) towards SDG 7. Umbria, with an even lower total allocation, adopted a similar strategy, directing 0.8 billion € (29.30%) of its total 2.73 billion € towards SDG 9 and 0.6 billion € (21.98%) towards SDG 7.

In southern Italy, Campania allocated a significant 7.6 billion € (41.93%) to SDG 9, indicating a strong emphasis on industrial improvement. Sicilia similarly allocated a substantial 6.7 billion € (43.38%) to SDG 9 and 2.7 billion € (17.48%) to SDG 11, underscoring a commitment to sustainable energy and industrial infrastructure development.

At the lower end, Abruzzo and Basilicata, while receiving smaller overall allocations, still directed their resources towards key SDGs aligned with their regional challenges, particularly in the areas of industrial development and sustainable energy. Abruzzo allocated 1 billion € (28.09%) to SDG 7 and 0.7 billion € (19.66%) to SDG 9 out of its total 3.56 billion €, while Basilicata directed 1.3 billion € (44.67%) towards SDG 9 and 0.6 billion € (20.62%) towards SDG 7 out of its total 2.91 billion €.

4.5 | Allocation of NRRP funds by SDG: Analysis by macro geographical area

Following our analysis of the funds allocated per SDG for each Italian region, Figure 5 aggregates the data into the broader zones of the south, northwest, northeast, center, and islands. This bar chart offers a comprehensive view of how the NRRP funds were distributed across these zones, segmented by SDG.

The southern regions received a total of 49.73 billion €, while the islands were allocated 20.58 billion €, resulting in a combined allocation of 70.31 billion €. This figure represents 38.3% of the total 183.43 billion € distributed across all regions, underscoring the strategic focus on reducing regional disparities and fostering balanced development. While both of these regions—which often face significant socio-economic challenges—were clear beneficiaries of the plan, it is important to note that their combined allocation remained lower than the 81.01 billion € (44.2% of the total funds) allocated to northern regions, and particularly the northwest.

On a per capita basis, the distribution presents a different narrative. The northeast received 2.82 thousand € per capita, the northwest 3.04 thousand € per capita, the center 2.74 thousand € per capita, the south 3.71 thousand € per capita, and the islands 3.23 thousand € per capita. Averaging the values between the northwest and northeast, the north received 2.93 thousand € per capita, while the south (including the islands) received 3.47 thousand € per capita. Of note, the population of the north (27.5 million) is nearly one-third larger than that of the south (19.8 million). Comparatively, the central region has a population of 11.7 million. These population figures, sourced from ISTAT as of January 1, 2024, illustrate the importance of considering both absolute and per capita figures in the allocation analysis.

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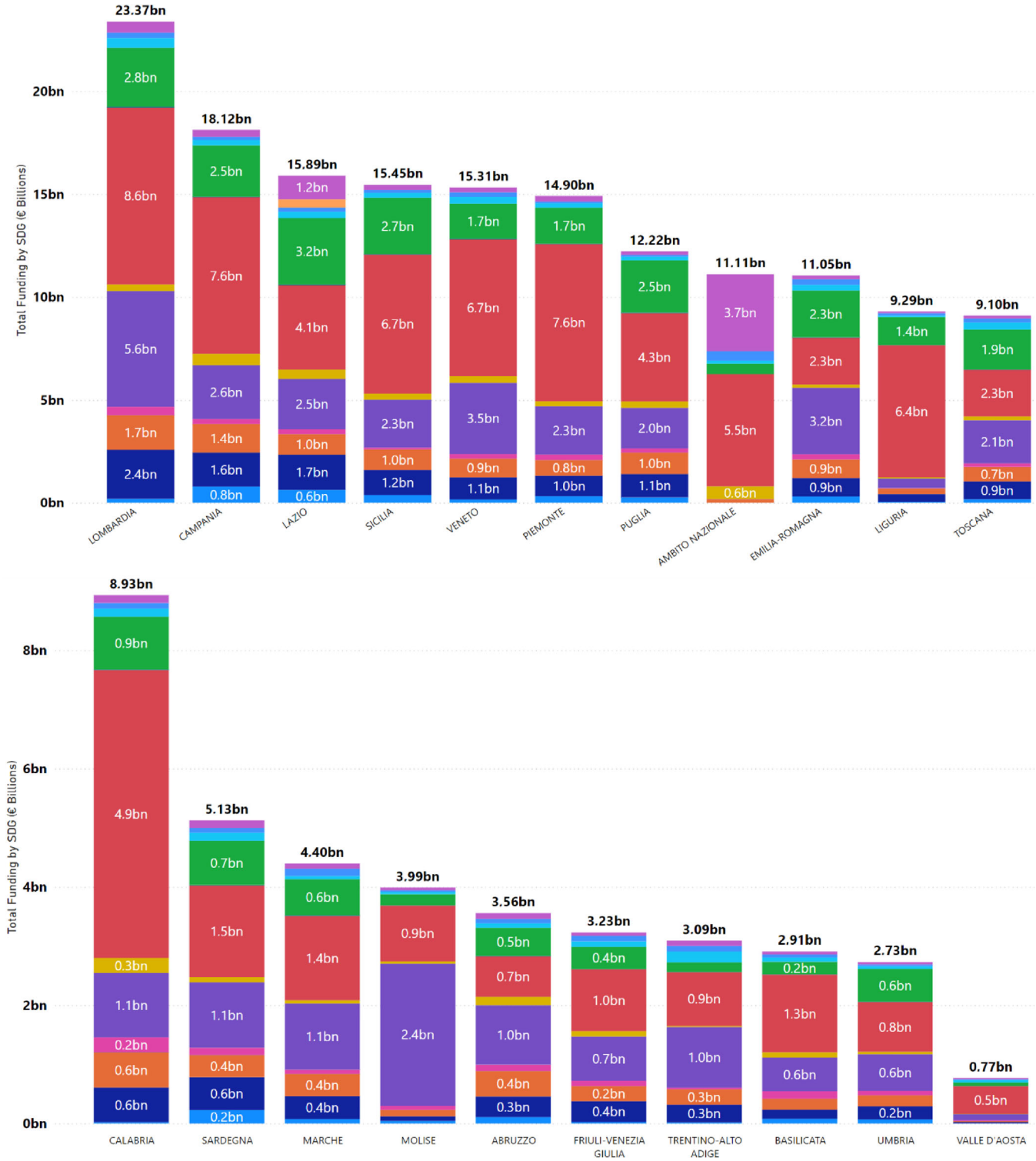

FIGURE 4 Regional allocation of national recovery and resilience plans funds by Sustainable Development Goals.

4.6 | Allocation of NRRP funds by SDG: Per capita analysis

The subsequent analysis focused on the regional distribution of funds on a per capita basis (Figure 6), providing a nuanced view of how the NRRP funds were apportioned across regions of varying population sizes.

The per capita approach allowed for a more equitable comparison, revealing that some regions, despite receiving smaller overall allocations, benefited from higher per capita funding. In northern Italy, regions such as Valle d'Aosta and Liguria received the highest per capita funding. Among the northern regions, Valle d'Aosta was allocated the greatest amount (6.24 thousand € per capita), highlighting its significant investment relative to its small population. Liguria

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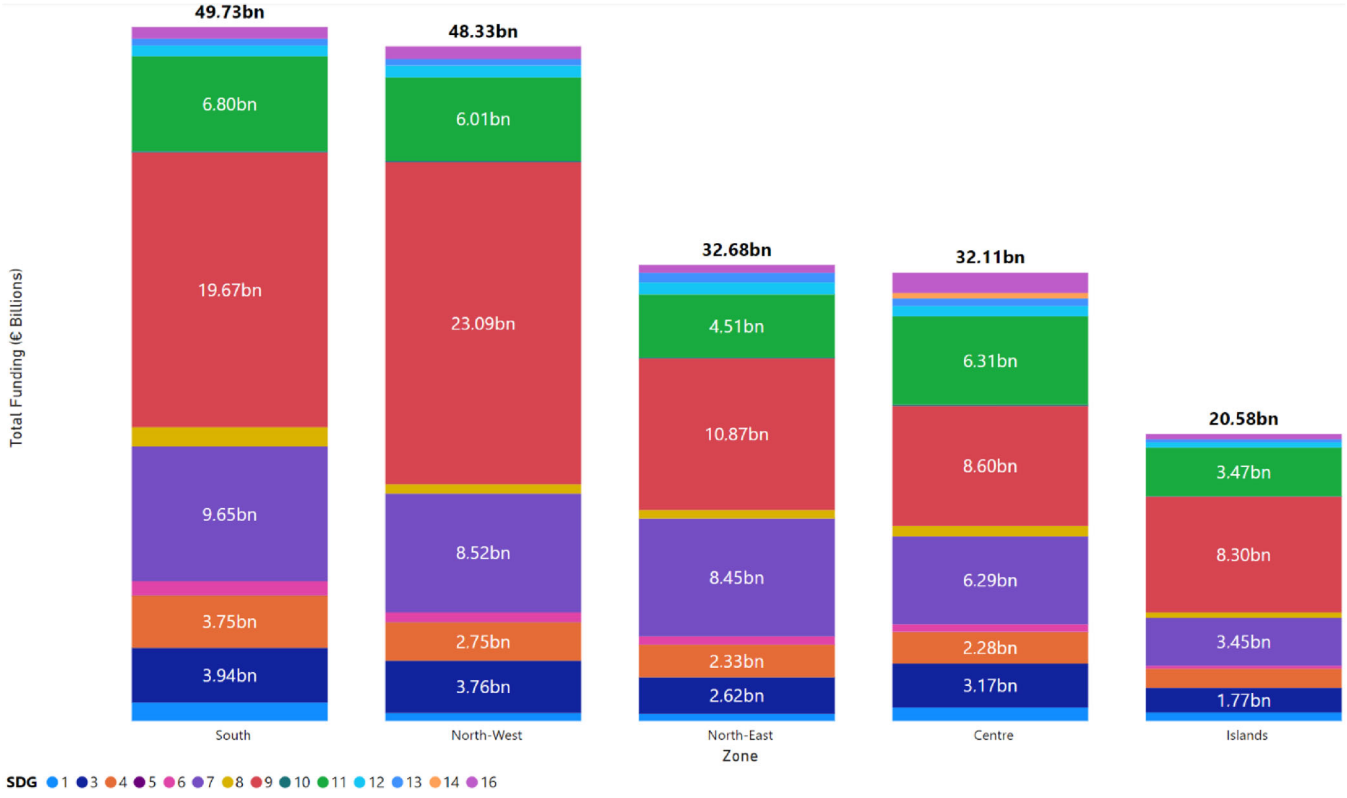

FIGURE 5 Allocation of national recovery and resilience plans funds by Sustainable Development Goals: Macro geographical perspective.

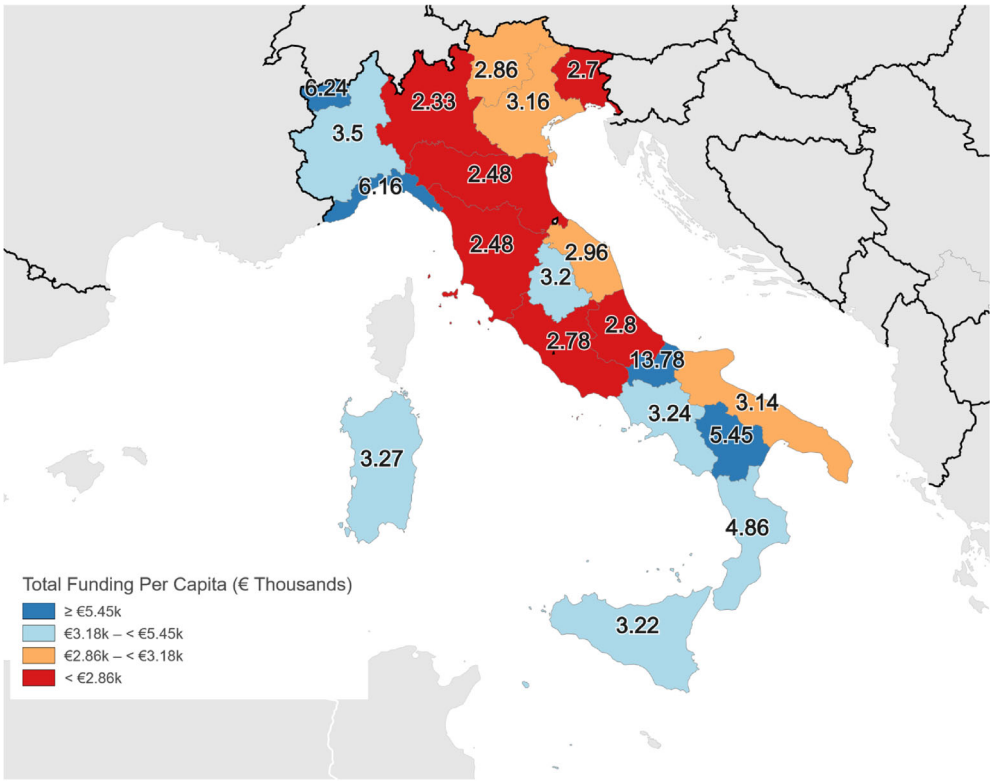

FIGURE 6 Allocation of national recovery and resilience plans funds by Sustainable Development Goals: Data per capita.

followed closely, with 6.16 thousand € per capita. Conversely, regions such as Emilia-Romagna and Lombardia received lower per capita allocations of 2.48 and 2.33 thousand € per capita, respectively. Central Italy presented a more moderate distribution of per capita funding. Umbria and Marche were among the top recipients, with Umbria receiving 3.20 thousand € per capita and Marche receiving 2.96

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thousand € per capita. In contrast, Lazio and Toscana were allocated relatively lower per capita funding of 2.78 and 2.48 thousand € per capita, respectively. Southern Italy and the islands received substantial per capita funding, again reflecting a focus on addressing regional disparities and promoting equitable development. Molise, in particular, received an exceptionally high allocation of 13.78 thousand € per

TABLE 1 Regional distribution of NRRP funds by SDG (€ per capita).

Region	SDG1	SDG3	SDG4	SDG5	SDG6	SDG7	SDG8
Abruzzo	86.44	273.15	337.25	2.00	82.57	793.83	112.28
Basilicata	150.73	288.21	345.73	1.98	232.99	1.066.50	167.54
Calabria	11.66	318.70	322.94	2.65	134.63	595.64	136.40
Campania	140.93	294.77	250.01	1.67	42.51	465.23	100.35
Emilia-Romagna	68.55	201.05	203.59	1.09	57.09	723.03	38.08
Friuli-Venezia Giulia	20.25	296.53	207.04	1.41	76.28	627.13	76.34
Lazio	110.57	297.31	176.57	1.15	39.33	428.78	79.11
Liguria	29.03	250.28	184.92	1.40	13.49	303.02	37.60
Lombardia	19.92	236.82	168.06	1.27	39.68	560.55	32.99
Marche	50.46	260.39	251.64	1.85	47.20	753.70	38.95
Molise	155.61	264.23	376.78	2.19	239.09	8.305.77	126.73
Piemonte	76.44	232.53	180.10	1.24	60.74	552.18	58.36
Puglia	68.84	290.82	266.23	1.79	51.68	507.80	79.80
Sardegna	144.94	353.03	237.17	2.02	77.06	706.51	54.25
Sicilia	79.01	253.08	209.45	1.51	16.29	487.71	61.21
Toscana	48.18	234.29	192.54	1.15	47.08	572.57	51.33
Trentino-Alto Adige	17.12	279.03	240.18	1.95	20.61	948.60	14.98
Umbria	78.44	262.08	217.74	1.73	86.58	721.35	49.18
Valle d'Aosta	14.63	181.32	145.19	1.72	128.19	809.17	61.17
Veneto	34.05	220.04	189.32	0.93	45.78	711.84	65.84

Region	SDG9	SDG10	SDG11	SDG12	SDG13	SDG14	SDG16
Abruzzo	536.70	9.01	370.74	60.67	56.74	0.00	79.27
Basilicata	2.464.29	9.38	401.12	133.93	93.77	0.00	96.32
Calabria	2.647.76	6.39	483.72	75.01	51.41	0.00	73.23
Campania	1.357.66	6.80	446.49	45.86	28.07	0.00	60.28
Emilia-Romagna	506.06	6.74	509.99	62.08	59.87	0.00	42.19
Friuli-Venezia Giulia	875.44	2.84	317.08	74.26	75.67	0.00	47.77
Lazio	713.65	9.03	562.30	53.32	34.56	69.93	201.91
Liguria	4.248.74	7.63	903.10	51.24	74.30	0.00	54.04
Lombardia	856.52	4.86	284.25	48.04	25.39	0.00	53.71
Marche	957.95	8.85	410.88	37.73	81.89	0.00	61.29
Molise	3.253.69	9.88	657.31	142.42	92.57	0.00	151.86
Piemonte	1.794.35	5.83	407.26	52.46	18.96	0.00	62.97
Puglia	1.100.23	8.26	652.64	45.28	24.11	0.00	44.67
Sardegna	986.88	8.18	474.07	87.99	50.53	0.00	83.25
Sicilia	1.407.24	5.19	568.52	49.53	29.58	0.00	54.08
Toscana	616.26	6.88	526.91	93.06	50.33	0.00	41.13
Trentino-Alto Adige	843.00	3.80	151.20	166.82	88.46	0.00	79.68
Umbria	985.23	7.65	649.53	53.31	33.88	0.00	51.94
Valle d'Aosta	3.748.52	15.28	523.46	323.18	111.52	0.00	171.68
Veneto	1.371.31	5.76	349.23	67.26	46.08	0.00	48.87

Abbreviations: NRRP, national recovery and resilience plans; SDG, Sustainable Development Goals.

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capita, indicating significant investment relative to its small population. Basilicata followed with 5.45 thousand € per capita. On the lower end, Puglia and Abruzzo received 3.14 and 2.80 thousand € per capita, respectively. While still significant, these allocations were far lower than those disbursed to other southern regions. These allocations aimed at boosting development in regions facing unique geographic and economic challenges.

This regional analysis, segmented into the north, center, and south, provides a comprehensive picture of the per capita distribution of NRRP funds. The per capita focus offers valuable insights into the distribution of resources and may contribute to ensuring that regions with smaller populations but greater needs receive adequate support in the future to promote sustainable development. Table 1 presents the complete breakdown for all SDGs.

4.7 | Regional group analysis

The allocation percentages assigned to two SDGs—SDG 9 (Industry, Innovation, and Infrastructure) at 294% and SDG 7 (Affordable and Clean Energy) at 24.2%—accounted for more than 50% of the total funding. To better understand the regional distribution of funds, a scatterplot was constructed for these two SDGs, dividing the regions into four quadrants according to the median values for SDG 9 (1043.5 € per capita) and SDG 7 (666.8 € per capita), as illustrated in Figure 7.

The upper-right quadrant of the scatterplot highlights that Molise received a particularly significant allocation of funds for SDG 7 compared to all other regions. Together with Basilicata and Valle d'Aosta, Molise was among the top five regions in terms of funding allocation for both of these critical economic SDGs. Notably, these three regions also ranked among the top four for per capita funding (Figure 6). While Liguria also occupied a high overall position, ranking third in per capita funding, it was not included in this group. Molise led with 13.78 thousand € per capita, followed by Valle d'Aosta, Liguria, and Basilicata with 6.24, 6.16, and 5.45 thousand € per capita, respectively. Finally, Veneto completed the group in this quadrant, holding an intermediate position in the distribution of funds for SDGs 7 and 9.

In the lower-right quadrant, Liguria emerged prominently, despite having received less than the median amount of funding for SDG 7. It occupied the top position for SDG 9, with a more significant allocation compared to other regions (also influencing its overall ranking). Calabria ranked fourth for SDG 9 and fifth overall, while Piemonte held a similar position, ranking fifth for SDG 9 and sixth overall. Finally, this quadrant also included Sicilia, Campania, and Puglia.

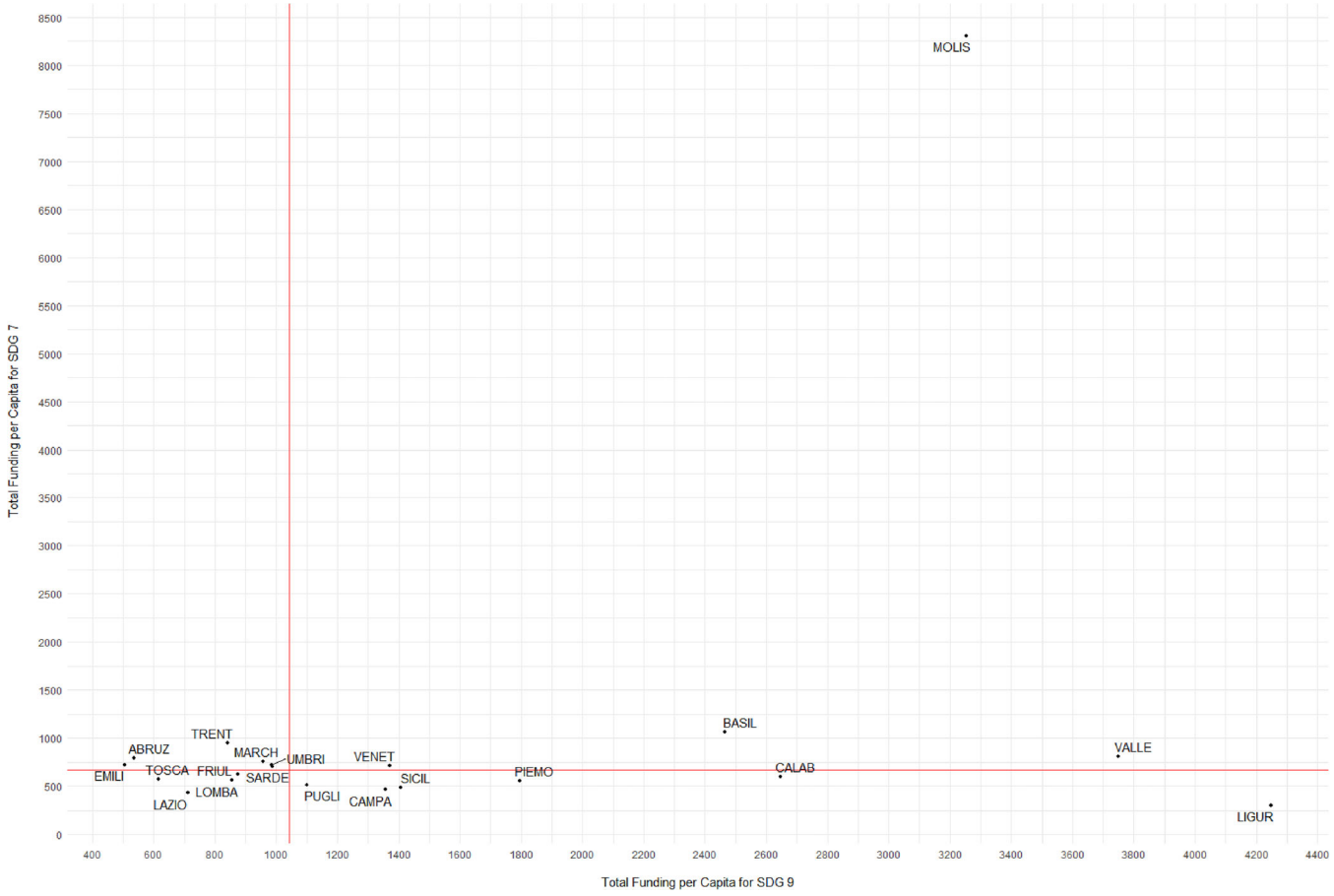

FIGURE 7 Regional group analysis based on Sustainable Development Goals (SDG) 7 (€ per capita) and SDG 9 (€ per capita). For clarity, regions are abbreviated to the first five letters.

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In the upper-left quadrant, two distinct groups emerged. The first group consisted of Trentino-Alto Adige, Marche, Umbria, and Sardegna. Unlike the preceding three regions, Sardegna exhibited a slightly higher median value for SDG 7, though it lagged behind in its funding for SDG 9. In contrast, Abruzzo and Emilia-Romagna not only ranked lowest for SDG 9, but they were also among the six regions with the least amount of per capita funding (Figure 6).

Moving to the bottom-left quadrant, Lazio, Toscana, Friuli-Venezia Giulia, and Lombardia all reported values below the medians for both SDGs. These regions, along with the previous two, occupied the lowest six positions in the funding allocation ranking. Notably, Lombardia received the least funding, at 2.33 thousand € per capita, followed by Toscana and Emilia-Romagna, with allocations of 2.40 thousand € per capita. The other regions—Friuli-Venezia Giulia, Lazio, and Abruzzo—received 2.70, 2.78, and 2.80 thousand € per capita, respectively.

Our analysis subsequently proposed a new scatterplot, with NRRP funds allocated to the economic SDGs 7, 8, 9, 11, and 12 plotted against the economic performance of the Italian regions, in accordance with the literature (D'Adamo et al., 2024a). While this new scatterplot provided valuable insights into the economic dimension, it is important to acknowledge that similar analyses could have been conducted for the social and environmental dimensions, but were not performed, as they lay beyond the scope of the study. Future research on these dimensions could be instrumental in providing a more comprehensive understanding of how NRRP funds influence various facets of regional development.

Similar to the previous analyses, this investigation also employed a quadrant-based approach, using the medians (2400.7 € per capita for the economic SDGs and 0.452 for the economic SDG index) as benchmarks (Figure 8).

The upper-right quadrant was composed of four regions receiving substantial NRRP funds and already exhibiting good economic performance. However, Liguria, Valle d'Aosta, and Piemonte, despite their positive economic SDG performance, still show potential for further improvement. The European funding thus represents a significant opportunity for growth, particularly in the northwest, in alignment with previous analyses (D'Adamo et al., 2024a). Finally, Veneto was also present in this quadrant, slightly exceeding the median allocation of funds.

In the upper-left quadrant, Lombardia, Trentino-Alto Adige, Emilia-Romagna, Friuli-Venezia Giulia, Lazio, and Toscana demonstrated strong performance on the economic SDGs, suggesting a lower priority for fund allocation in the economic dimension. Two

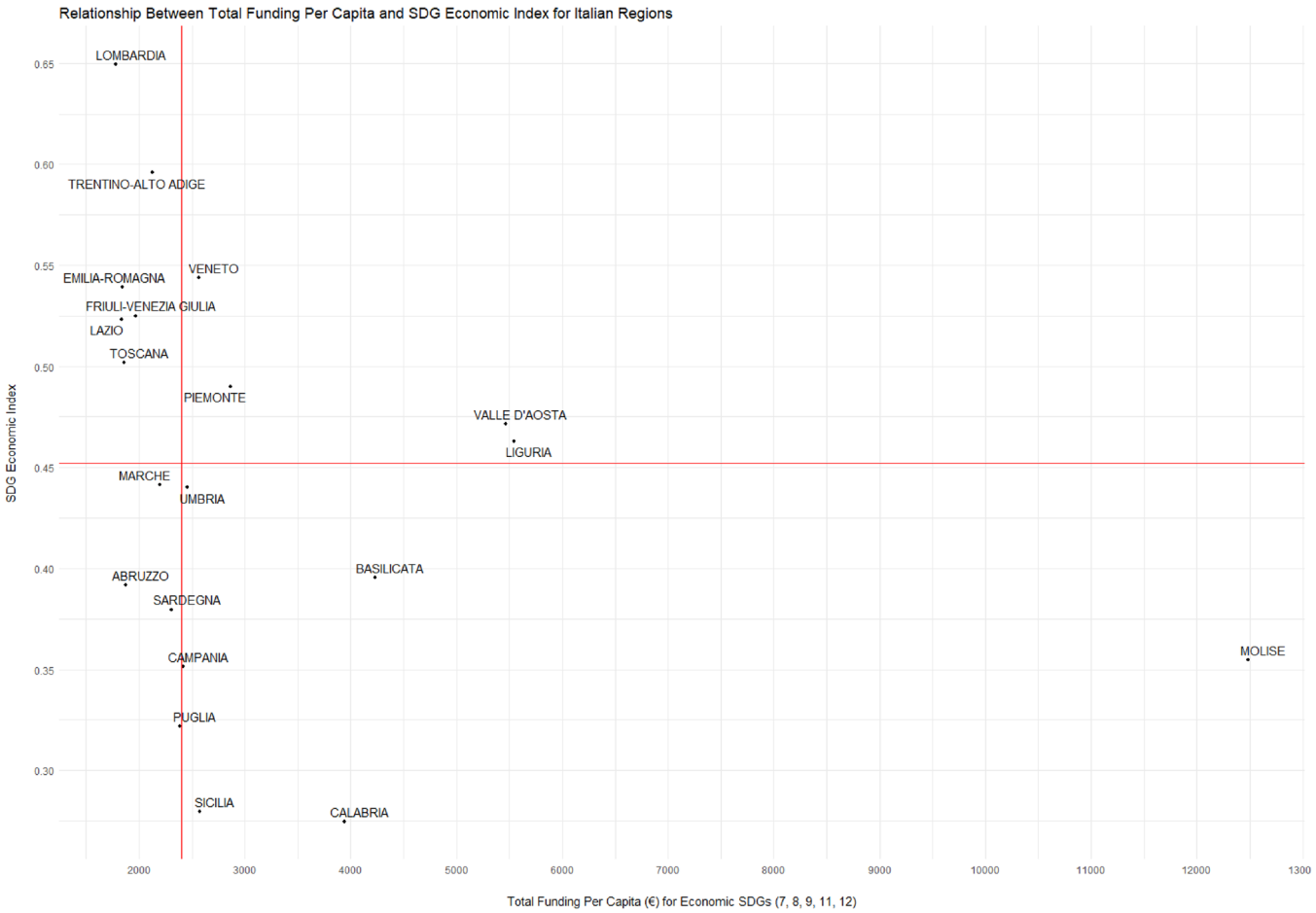

FIGURE 8 Regional group analysis according to the total funding for the economic Sustainable Development Goals (SDGs) (€ per capita) and the SDG economic index (dimensionless).

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observations are pertinent here: first, these regions ranked among the top seven in the overall economic SDG ranking (with Veneto placing third); and second, these regions, together with Abruzzo, occupied the last seven positions in terms of the allocation of funds for the economic SDGs.

The third quadrant, located in the bottom right, revealed a diverse range of situations. Molise, as already highlighted, benefited from a significantly higher allocation of funds. Moreover, Basilicata stood out as the southern region with the best performance against the economic SDGs. Umbria, the only central region in this group, exhibited a value slightly above the median, on par with Campania. The group was completed by Sicilia and Calabria, occupying the lowest positions in the economic SDGs ranking. Of note, Molise and Campania were among the bottom five regions in this ranking—a group that also included Puglia, which was otherwise absent from this quadrant. The allocation of funds appears appropriate for potentially reversing current trends.

Moving on to the final quadrant (lower left), we find the last four regions to be examined. Puglia, with a score just below the median, merits special attention due to its current situation. The same goes for Sardegna, whose fund allocation was also close to the median. Marche, on the other hand, presents a different scenario, as its economic performance was close to the median. Thus, while it might benefit from additional funds, its situation is less critical than that of Puglia and Sardegna. Abruzzo concluded the list as one of the regions with the lowest allocations of economic funds. The analysis therefore indicated that more attention and greater financial support is necessary to address a disparity in the initial plan for the allocation of funds. Although Abruzzo underperformed against the economic SDGs, it exhibited significant stronger sustainability performance compared to all other southern regions, thereby justifying a greater allocation of funds. The region's transitional status—typically defined on the basis of a GDP per capita between 75% and 100% of the EU average—might hinder its ability to secure national funds. The European Union Cohesion Policy, however, provides special attention and funding for regions in transition to promote economic growth, improve competitiveness, and respond to structural challenges. Despite Abruzzo's progress, it has inadequate levels of investment to achieve full integration with the more developed regions of Italy and the EU. The primary concern for Abruzzo, therefore, lies in improving "economic well-being" and fostering "innovation, research and creativity" (D'Adamo, Di Carlo, Gastaldi, & Uricchio, 2024). Encouragingly, data

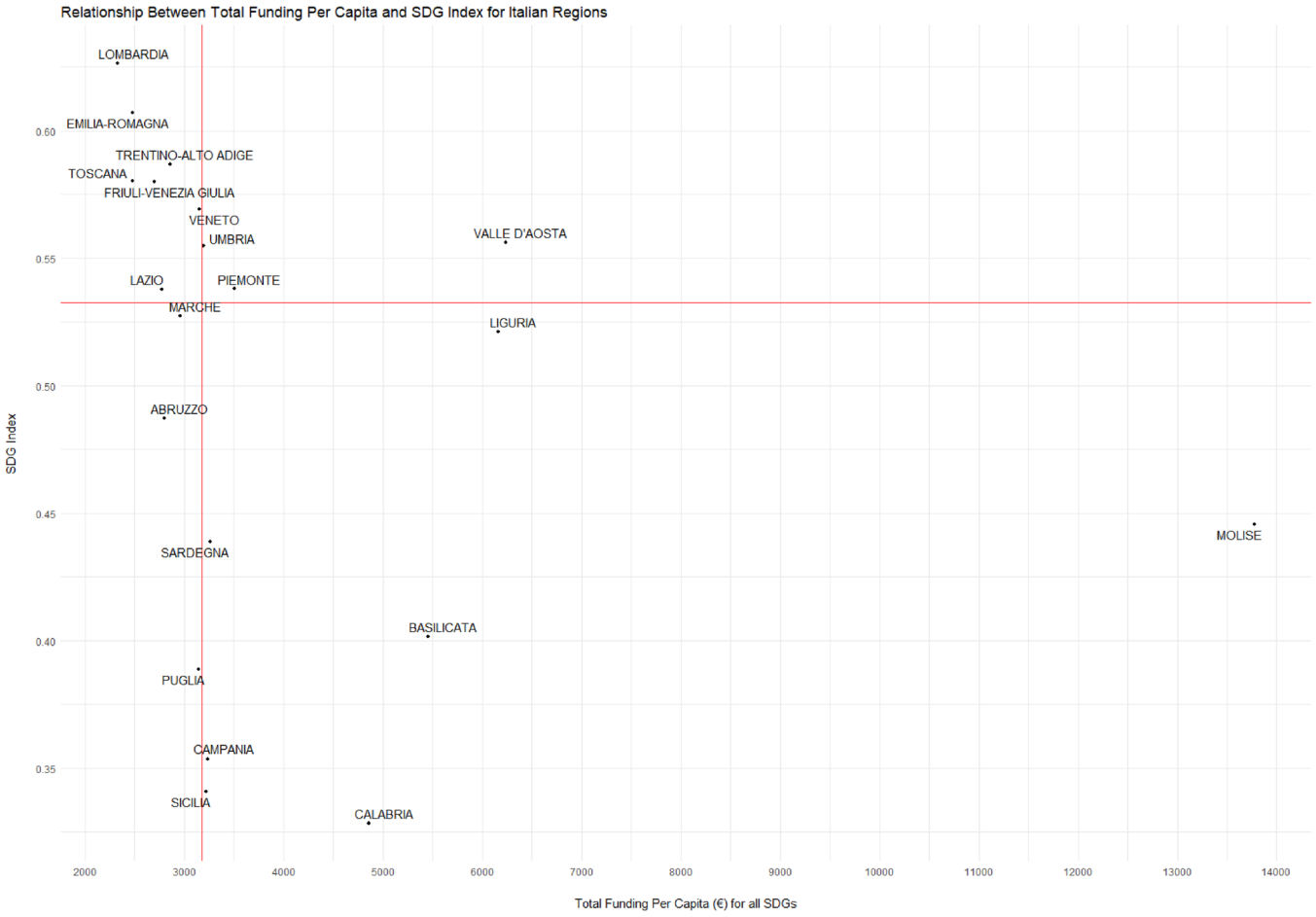

FIGURE 9 Regional group analysis according to the total funding for the overall Sustainable Development Goals (SDGs) (€ per capita) and the SDG overall index (dimensionless).

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from 2022 indicate improvements over 2018 in terms of overall SDG performance (D'Adamo et al., 2024a).

Although the present analysis focused primarily on the economic dimension, the same approach was extended to consider all three dimensions of sustainability. A quadrant-based analysis was proposed for this purpose, using the medians (3177.5 € per capita for the overall SDGs and 0.533 for the overall SDG index) as benchmarks (Figure 9).

The transition from an economic-focused analysis to one encompassing broader dimension resulted in four regions shifting their positions within the quadrants. In the upper-right quadrant, the placement of two northeastern regions (Valle d'Aosta and Piemonte) was reaffirmed, while Umbria emerged as a new entry. Notably, Umbria was below the median in the SDG index for the economic dimension but surpassed this threshold in the overall SDG index.

In the upper-left quadrant, several regions remained consistent: Lombardia, Emilia-Romagna, Trentino-Alto Adige, Toscana, Friuli-Venezia Giulia, and Lazio. Additionally, Veneto emerged anew, despite its overall funding remaining below the median.

The lower-right quadrant continued to include Molise, Basilicata, Calabria, Campania, and Sicilia, but Sardegna joined the quadrant, having received more funds than the median at the overall level (in contrast to the economic dimension). Additionally, Liguria, which had previously had a higher economic sustainability indicator, fell below the median in the overall assessment.

Finally, the positions of Marche, Abruzzo, and Puglia in the bottom-right quadrant were confirmed, albeit with notable distinctions. Marche was situated close to the origin of the axes, suggesting its possible outlier status. Puglia maintained its previously observed position, with a total funding allocation near the median. However, the critical challenges associated with Abruzzo were reaffirmed.

5 | DISCUSSION

The relevance of the SDGs is rapidly increasing within the academic literature (Ordonez-Ponce, 2023), making it crucial to monitor their relationship with economic well-being (Cook & Davíðsdóttir, 2021). In this context, this paper has introduced a novel perspective. As Europe transitions towards models of sustainability, two distinct perspectives are emerging (D'Adamo et al., 2024c): one ideological and the other pragmatic. Pragmatic sustainability, in particular, offers concrete solutions and seeks to benefit all stakeholder categories. A shift in attitude is necessary to embrace a new mindset that avoids premature criticism and focuses on identifying problems and offering real solutions. NGEU initiatives have significantly benefited Europe by facilitating access to public money and reducing bureaucratic delays that frequently hinder the implementation of projects (Aydin & Degirmenci, 2024; Schramm & Terranova, 2024). However, bureaucratic inefficiencies are sometimes used as an excuse to justify decision-making paralysis favoring certain stakeholder categories. Some analyses have focused on the political and regulatory aspects of reform analysis and implementation (Buti & Fabbrini, 2023; Di Mascio & Natalini, 2023; Pritoni et al., 2023). In the present study, Italy was used as a case study due to its status as the largest recipient of NGEU funds. The analysis showed a close correlation between the NRRP and the SDGs (Perchinunno et al., 2023), highlighting variations in the allocation of funds across different SDGs over time, while also identifying common patterns. For instance, SDGs 7, 8, and 9 exhibited similar outcomes, while SDG 13 presented a different trend (Cavalli et al., 2023).

Analyses of dataset management are critical for identifying policy implications (Cohen, 2017) and monitoring the progress of related plans and projects (D'Adamo & Gastaldi, 2023). The availability of open data further enhances these efforts by promoting transparency, enabling broader participation, and facilitating independent verification and innovative use of the data (European Commission, 2020). Previous studies have focused on localized contexts, revealing the negative impact of population size on the SDGs of Italian municipalities (Raimo et al., 2024). However, in any sustainability analysis, it is crucial to consider not only economic-political dimensions but also the dynamic role played by sustainable policies and political stability in ensuring continuity in administrative decisions to balance green public investment with the rationalization of public spending (D'Adamo et al., 2022). Although territorial disparities are evident across regions, national unity remains a central tenet in Italy. For example, the "Made in Italy" initiative promotes an innovative and sustainable model based on regional synergies, optimizing local resources and expertise to maintain global competitiveness. In this direction, the Mattei Plan may play a crucial role (D'Adamo et al., 2024a). Importantly, territorial disparities are not unique to Italy (Puertas & Marti, 2023). Thus, the Conference of Regions could serve as a strategic platform to address regional disparities, provide a voice for territorial emergencies, and seek consensus on critical issues. This perspective is echoed in the opinion piece "A Just Transition for All EU Regions," authored by Marco Marsilio, President of the Abruzzo region, and Stefano Cianciotta, an expert nominated by the Committee of the Regions. This opinion, adopted by the Coter Commission of the European Committee of the Regions in July 2024, emphasizes the importance of conducting ex-ante analyses across the three dimensions of sustainability, advocating for technological neutrality and the development of models utilizing available resources while avoiding overdependence on Asia. Moreover, it underscores the need for economic and territorial development that safeguards jobs, promotes ecosystem-conscious industries, and positions public administration as a primary actor.

While region-specific analyses can be derived from the present results (D'Adamo et al., 2024b), the specificity of the results also presents a limitation of the work. A second critical issue concerns the allocation of funds, which in many cases supported multiple regions, rather than single regions, especially with respect to projects with national scope. Additionally, a further limitation lies in the reliance on the baseline SDG index, which depends on the availability of sustainability indices in both numerical and temporal terms. Although specific indicators were selected for the present analysis, it is important to acknowledge that the literature proposes multiple approaches to measuring sustainability performance (Mazziotta & Pareto, 2018; Ricciolini

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et al., 2024; Richiedei & Pezzagno, 2022). While data monitoring is essential, significant changes are needed to achieve greater uniformity across territories. Furthermore, assessments of investment impact are needed to determine success. In cases where time constraints have limited the completion of certain projects, specific exceptions must be made if the projects are deemed instrumental for achieving sustainability goals, in both Italy and Europe. The central objective of this and similar region-level analyses is to foster the implementation of sustainable communities. Realizing this objective will require the adoption of Essential Levels of Performance (LEPs), aimed at addressing territorial disparities in service accessibility (D'Adamo et al., 2024b). LEPs are essential for safeguarding civil and social rights for all citizens. To reduce—or at least mitigate—the north–south divide, it will be crucial to consider all public interventions in aggregate (including development and cohesion funds) and evaluate the extent to which these measures effectively support LEPs.

In this context, "Made in Italy" may serve as a strategic lever, distinguishing Italy in the global marketplace across a variety of sectors. The fusion of resources this initiative involves extends beyond the mere combination of physical and human resources, and also encompasses tourism, culture, and religion—elements that collectively underscore Italy's unique identity. Similarly, to remain competitive amid ecological and digital challenges, businesses must be equipped with the necessary infrastructure and public administrations must embrace change, fostering a workforce with the appropriate blend of new and existing skills. In addition, a particular emphasis must be placed on healthcare, as sustainability efforts cannot be separated from the protection of human welfare. Where parochialism is set aside in favor of a spirit of brotherhood and collaboration, stakeholder engagement may bring sustainability closer to addressing real-world issues and offer practical tools for the resolution of these issues. Public funds should serve this purpose: to provide opportunities for future generations while mitigating existing challenges.

6 | CONCLUSIONS

The NGEU initiative represents a significant opportunity for Europe, contingent on the efficient and effective use of allocated funds. While the timeframes for project completion incentivize swift action, they also pose challenges for projects requiring longer durations than those permitted by the plan. In addition, although the debt tranches are offered on favorable terms, careful consideration is essential, particularly for countries with high levels of public debt. In this context, Italy's NRRP presents both a valuable opportunity and a substantial risk. Current progress, reflected in the successful payment of the first five tranches, suggests that the approach of the Italian government has thus far been deemed satisfactory by the European Commission.

The NRRP has allocated approximately 194 billion €, with 55.5 billion € designated for the "Green Revolution and Ecological Transition" and 104.1 billion € primarily linked to SDGs 7 and 9. Of the total allocation, 11.1 billion € has been earmarked for specific regions. Lombardia has received the most, with 23.37 billion €, followed by Campania with 18.12 billion € and Lazio with 15.89 billion € (i.e., the three regions with the largest populations). Notably, the policy's emphasis on SDGs 7 and 9 is reflected in the regional distribution, with funds for SDG 9 dominating across most regions. However, in Trentino Alto-Adige, Emilia-Romagna, Abruzzo, and Molise, more funds have been directed towards SDG 7. Furthermore, the NRRP may be viewed as a tool to address economic disparities between the north and south of Italy. The open data analysis indicated that southern regions, including the islands, have been allocated 70.31 billion €—a value significantly less than the 81.01 billion € assigned to northern regions (particularly the northwest). Central Italy has received 32.11 billion €, despite having half the number of regions compared to the other two macro-regions. On a per capita basis, the distribution picture shifts: the north has received 2930 € per capita, the center 2739 € per capita, and the south (including the islands) 3470 € per capita. This reflects the fact that the population of northern Italy is approximately one-third larger than that of southern Italy. At the regional level, Molise stands out with a per capita allocation of 13.78 thousand €, followed by Valle d'Aosta, Liguria, and Basilicata with 6.24, 6.16 and 5.45 thousand € per capita, respectively. With the exception of Liguria, these are the least densely populated regions.

As these findings demonstrate, population size has significantly impacted the distribution of funds. However, given the NRPP's goal of narrowing the north–south divide, there is a strong case for directing more resources towards the south to invest in strategic assets and foster long-term regional parity.

The present results reveal a strong correlation between the allocation of funds and the focus on two key SDGs. For SDG9, Liguria has received the greatest amount of funding, while Abruzzo and Emilia-Romagna have received the least. Conversely, for SDG 7, Molise ranks at the top, while Lazio and Liguria occupy the lowest positions. However, to better understand these results, we must compare this fund allocation with regions' current performance against these SDGs.

The present analysis evaluated the impact of regional investments on sustainability goals, offering important insights for European, national, and local policymakers. The objective was not to critique whether certain regions have received disproportionately high funding relative to their needs, but rather to emphasize the strategic focus on Italy's southern region. Molise, in particular, along with Basilicata, Calabria, and Sicilia, has received substantial resources to address socio-economic challenges. However, regions such as Sardegna, Campania, and Puglia present a more intermediate scenario, being close to the bottom of the distribution curve. Of note, Sardegna has received less in terms of economic funding, but performed more favorably in the other two sustainability dimensions. In contrast, Puglia is slightly below the median across the overall and economic dimensions, suggesting that it may benefit from additional resources. Similarly, the Marche region, while situated near the origin of the axes in terms of fund allocation and performance, would benefit from further attention and support. Particular attention should also be given to the Abruzzo region, often referred to as the "green region of Europe," due to its strong potential for sustainability development, as highlighted in previous analyses.

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The study identified three Adriatic coastal regions (i.e., Marche, Puglia, Abruzzo) as consistently receiving below-median funding from the NRRP, despite demonstrating above-median sustainable performance based on key indicators. A pragmatic model of sustainability, aimed at fostering balanced economic and territorial development, must emphasize fraternity and cooperation among all Italian regions to both advance a unified strategy (leveraging the "Made in Italy" brand) and promote sustainable development.

The present findings have important policy and research implications for a wide range of stakeholders. By enhancing awareness of the policies shaping future regional development, the research contributes to a broader awareness of how public funds may drive sustainability outcomes. Although the study was focused on Italy, its methodology can be replicated to compare other European regions or countries. Such comparisons could allow for a deeper analysis of the correlation between public funding and sustainability performance across territories, shedding light on whether existing regional disparities may be mitigated by a community-oriented, sustainable development approach.

AUTHOR CONTRIBUTIONS

All authors equally participated in the definition and writing of this paper.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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