

# Does local context affect the contribution of green Cohesion Policy funds to air pollution reduction?

Francesco Scotti<sup>\*1</sup>, Giovanni Bonaccorsi<sup>1</sup>, Alessandro Buongiorno<sup>2</sup>,  
Andrea Gilardi<sup>3</sup>, Mario Intini<sup>2</sup>, Valeria Maria Urbano<sup>1</sup>, Andrea Flori<sup>1</sup>,  
and Angela Bergantino<sup>2</sup>

<sup>1</sup>*Department of Management, Economics and Industrial Engineering, Politecnico di Milano,  
Via Lambruschini, 4/B, 20156, Milan, Italy.*

<sup>2</sup>*Department of Economics, Management and Business Law, University of Bari Aldo Moro,  
Italy, Largo Abbazia S. Scolastica 53, Bari, Italy*

<sup>3</sup>*MOX - Dipartimento di Matematica, Politecnico di Milano, Piazza Leonardo da Vinci 32,  
20133 Milano, Italy*

*\* corresponding author: francesco.scotti@polimi.it*

## Extended Abstract

Complete ex-post assessments on the impact of the EU Cohesion Policy suggest that the effectiveness of this regulatory framework was negatively affected by the wide set of targeted development axes, leading to fragmented spending across the different priorities with a lack of critical mass ([Barca, 2009](#)). Furthermore, the EU Cohesion Policy was characterized by insufficient consideration of the "logic of intervention", meaning that the regulation missed a clear implementation strategy to achieve the defined targets ([CPMR, 2014, 2015](#)).

As a consequence, in 2013 this policy framework was subject to significant and substantial regulatory changes, ensuring a stronger alignment between policy objectives and funds allocation and a greater thematic concentration focusing on environmental targets ([Vironen et al., 2019](#)). Consistently, the sustainability transition constituted one of the main pillars of the programming period 2014-2020 absorbing 161 billion euro corresponding to more than 30% of the total available budget. Indeed, sustainability transition

is commonly seen as a key option to combat climate change and comply with international targets established by the European Commission aiming to reduce greenhouse gas emissions to at least 55% below 1990 levels by 2030, and achieve carbon neutrality in 2050.

Despite such growing interest on the effects generated by environmental funds in terms of carbon abatement, extant literature has mainly focused on the analysis of the socio-economic impact of Cohesion Policy funds, considering the GDP per capita and employment as main outcome variables (see e.g., [Gripaios et al. \(2008\)](#), [Mohl and Hagen \(2010\)](#), [Pieńkowski and Berkowitz \(2016\)](#), [Dall’Erba and Fang \(2017\)](#) and [Scotti et al. \(2022\)](#)). Moreover, the still limited set of studies discussing how public funds may contribute to reduce  $CO_2$  emissions has not adequately investigated how the effects of such programs of financial support targeting the environmental sector may vary depending on the local set of capacities, representing the the stock of tangible and intangible assets that contribute to the local sustainable development. Indeed, there is a strong debate on the role of the local context to mediate the impact of EU Cohesion policy funds ([Fratesi et al., 2014](#); [Fratesi and Perucca, 2016, 2018, 2019](#); [Bachtrögler et al., 2020](#)). If existing contributions show that public funds have a larger impact on firms growth in regions with lower income or limited endowments of territorial assets, we still lack evidence on how the local set of capacities may influence the outcome of financial support initiatives targeting carbon abatement.

Against this background, this paper aims to fill this gap by analysing the impact of green EU Cohesion Policy funds in terms of PM2.5 air concentration reduction in Italy over the time frame 2014-2020. In particular, we also discuss the heterogeneity of such effects across territories with a different endowment of territorial capital. To do this, we built a comprehensive dataset on the set of projects financed by the EU Cohesion Policy focused on the sustainability transition, relying on the Open Coesione data platform.<sup>1</sup> In particular, we focus on the European Regional Development Fund

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<sup>1</sup>Information related to projects implemented by each Italian region within the EU Cohesion Policy framework is available at the following link: [https://opencoesione.gov.it/it/opendata/#!/progetti\\_regione\\_section](https://opencoesione.gov.it/it/opendata/#!/progetti_regione_section).

(ERDF) and the European Social Fund (ESF), since with 199 and 84 billion € they represent two main funds within the EU Cohesion Policy framework. Moreover, differently from other programs of financial support, such as the European Maritime and Fisheries Fund and the Fund for European Aid to the Most Deprived, the ERDF and the ESF are allocated to all Italian territories and not only to sub-specific areas, thus allowing us to compare the effects generated by these funds across different municipalities in Italy.

Since our research purpose is to analyse the capability of funds allocated within the EU Cohesion Policy framework to contribute to carbon abatement, we restrict our analysis to projects related to “low carbon economy and energy efficiency”(thematic objective 4) or pertaining to other thematic objectives but including in their description a set of keywords strongly connected with air pollution reduction.<sup>2</sup> In this way, we provide a complete overview on the set of projects targeting the sustainability transition with a specific focus on emissions abatement. We collected data related to 10,468 projects and we aggregated green funds allocation and expenditures at the scale of municipality, the spatial level of our analysis. Overall, our dataset covers 4,941 Italian municipalities receiving public funds from Cohesion Policy with a specific target on emissions reduction over the time-frame 2014-2020.

We rather construct the level of PM2.5 emissions based on satellites data disclosed by the European Environmental Agency (EEA) covering the time frame 2014-2021. In particular, we rely on air pollutants concentrations grids (1km<sup>2</sup> x 1km<sup>2</sup>) combining monitoring air quality data in a ‘regression-interpolation-merging mapping’ methodology. We compute the yearly level of PM2.5 in every Italian municipality as a weighted average of the pollutant concentration in each grid based on the portion of the overlapping area between the grid and the considered administrative unit.

To investigate our research question, we implement a panel Spatial Durbin Model (SDM), based on the following equation:

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<sup>2</sup>Here, we provide a short list of some of the keywords we used to identify projects with a focus on carbon abatement: “Energy efficiency”, “Emissions”, “Renewable”, “CO<sub>2</sub>”, “Co-generation”, “Air pollution”.

$$Y_{i,t} = \lambda W * Y_{i,t} + \beta_0 + \beta_1 \textit{Green Funds}_{i,t} + \beta_2 * \textit{Green Funds}_{i,t} \gamma X_{i,t} + \epsilon_{i,t}$$

where  $Y_{i,t}$  is our dependent variable computed as the percentage variation of PM2.5 concentration in municipality  $i$  in year  $t$ . We include the spatial autoregressive component  $W * Y_{i,t}$  to account for potential similar pollutant concentration dynamics in close municipalities. Moreover,  $\textit{Green Funds}_{i,t}$  is the expenditure of green funds allowing us to capture the direct contribution of such programs of financial support to the reduction of pollution in the municipality where projects are implemented (direct effect). The term  $W * \textit{Green Funds}_{i,t}$  is rather responsible for spillover effects (indirect effect) since the expenditures of green funds in a municipality may also have an impact in terms of PM2.5 reduction in neighbourhood municipalities. Finally,  $X_{i,t}$  is a vector of control variables including meteorological factors that could affect the pollutants concentration such as the wind speed, rain level, temperature and humidity (Zhou and Levy, 2007; Zhang et al., 2015; He et al., 2017). We test the robustness of our results through alternative specifications of the spatial matrix  $W$  defined based on the K-Nearest Neighbours ( $k = 10, 20, 30, 40, 50$ ), Queen and geographical distance logic.

Since our research objective is to disentangle the impact of green funds across territories with a different territorial context, we also apply a cluster analysis on Italian municipalities based on a representative set of social, economic, environmental and demographic variables. We find that our territories of interest can be separated in three clusters with consistent results based on alternative hierarchical and non hierarchical clustering methods and based on alternative definition of distance across groups. In particular, the first cluster mainly encompasses territories in the Centre-North of Italy, displaying high levels of economic capital (e.g., income per capita, employment levels) and infrastructure endowment. The second cluster is characterized by touristic areas with a strong concentration of accommodation infrastructures. Finally, the third cluster accounts for municipalities located in the Centre-South of Italy, with a good level of Human Capital (e.g., education level).

When analysing the whole sample of municipalities receiving green funds, we observe both a direct and indirect effects in terms of PM2.5 reduction. Indeed, these programs of financial support contributes to reduce emissions both in the municipality directly receiving them, but also in the neighbour areas. However, we show how this finding is the result of heterogeneous dynamics across territories with different levels of territorial capital. Indeed, we confirm our main result when we restrict the analysis to municipalities in the cluster with high economic capital and infrastructure endowment. On the other hand, we find evidence of only significant spillovers in territories with a strong presence of the Tourism sector. Neither direct nor indirect effects are observed in our third cluster, including territories with a good human capital and mainly located in the Centre and South of Italy.

We show how such results hold also in case we perform some robustness checks where we restrict the analysis to a subset of municipalities in the three clusters spending a comparable amount of green funds in the time frame 2014-2020, thus corroborating that the heterogeneous effects generated by these funds might be driven by the local level of territorial capital and not by the different intensity of expenditures across municipalities. Our results are consistent across the alternative proposed spatial matrices, thus suggesting that our findings are not mainly dependent on how we define the concept of neighbour municipalities. Finally, we discuss how the stronger effectiveness of green funds in municipalities of Cluster 1 (municipalities in the Centre-North of Italy with high economic capital and infrastructure endowment) might be related to the local high quality institutional capacity and to the capability to select and implement projects actually contributing to carbon abatement.

Overall, our paper develops an insight on the effects generated by green Cohesion Policy funds in terms of PM2.5 reduction across territories with heterogeneous levels of territorial capital, supporting policy makers to further refine and improve this regulatory framework aiming to contribute to carbon abatement targets.

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