



# Cohesion policy and domestic fiscal expenditure in Italian regions: A sectoral ex-post assessment of the additionality principle

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## ABSTRACT

The additionality principle of the European cohesion policy was verified ex-ante by the European Commission and was eliminated starting from the 2021–27 programming period. However, the cohesion treatment may have ex-post reduced, in some cases, national spending and the decision to eliminate the principle should have been taken under a case-by-case scrutiny. The application of the additional principle has been suggested for more recent anti-crisis fiscal policy programmes and some authors have claimed a reintroduction of it for cohesion policy. This paper deals with an ex-post sector-by-sector evaluation of the additionality principle in the European cohesion policy with respect to domestic fiscal policy during the two most recently concluded programming periods (2007–13 and 2014–20). The application is carried out for the Italian regions. In particular, we look at how the relationships between cohesion policy and domestic non-cohesion fiscal policy may differ for specific sectors (education, culture, transportation and environment) employing a regional panel framework and addressing the issues of endogeneity and reverse causality explicitly. We construct a unique database which combines two sources of information available for the Italian case. The first includes information on cohesion projects while the other refers to the regionalized public expenditure obtained by consolidating all different sources of spending. We found strong sectoral heterogeneity in the compliance with the additionality principle. Cohesion policy in education and environment appears to display a substitution effect. On the contrary, cohesion policy seems more additional to domestic expenditures in transportation infrastructures. The analysis found some differences in the compliance with the additionality principle also among Italian regions. Sectoral and regional heterogeneity should be taken into account in practical policymaking.

## 1. Introduction

The European cohesion policy is supposed to enhance regional economic convergence by financing investment projects mainly addressed to lagging territories.

The 1988 Reform of European Structural Funds tackled the implementation process specifically with the establishment of the additionality principle according to which EU Funds should not be used to replace domestic resources.

The concept of additionality has a relevant theoretical background since it claims to avoid the potential pitfall occurring when cohesion treatment displaces national (so called ‘ordinary’) capital account expenditure; a desirable effect of European intervention should be to create a stimulus for national investment policy. Moreover, the rule is conducive to a pro-active behavior in monitoring Funds’ expenditure by

the European Community (Bernet and Borooha, 1995).

If distortions occur, the recipients of the EU Funds may use them not for cohesion purposes but mainly for other unrelated projects (Mohl, 2016).

Very few rigorous assessments have been carried out on the empirical application of the additionality principle. The assessment has taken place mainly at NUTS-1 level for a panel of European countries or, at a more detailed level, in single country exercises with mostly descriptive analyses. In Italy, some exercises (Del Bo and Sirtori, 2016) have traced sectoral and regional displacement effects in an accounting time series framework. The findings of these studies are quite heterogeneous and there is no conclusive agreement on the evaluation of the impact of the additionality rule.

Our novelties with respect to the existing literature are the following. We produce ex-post empirical evidence of the compliance with the

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additionality principle in Italy by analysing the two most recently completed programming periods (2007–13 and 2014–20).

We apply, for the first time in the literature, a sectoral breakdown of cohesion and domestic fiscal spending in a panel data specification for Italy at the regional (NUTS-2) level.

The sectoral analysis allows us to discover the potential differences between expenditure sectors and, in a panel framework, to include individual regional characteristics and sectoral features.

The work employs two jointly combined different data sources, the Italian database on cohesion policy expenditure (*Opencoesione*) and the Italian database on the overall regionalized public spending (*Conti Pubblici Territoriali*). In the existing literature on the Italian economy there are no empirical studies which use these two databases in an integrated way.<sup>1</sup>

In our panel model, (non-cohesion) domestic fiscal expenditure in each sector is explained by the cohesion spending in that sector and by some regional and sectoral control variables. In this framework, the endogeneity of the cohesion variable may be an issue. Indeed, cohesion funds might depend on both domestic funds and explanatory control variables. For this reason, we specifically investigate the potential endogeneity of the cohesion variable before proceeding to model estimation. We also control for the robustness of the results through 2SLS and GMM approaches.

The analysis concerns five sectors of public spending: *Education, Road Infrastructure, Other Transport Infrastructure, Environment and Culture*, which may be considered among the most important dimensions of regional growth. In addition, these sectors account for almost 60 % of expenditure on cohesion projects and 12 % of the overall regionalized expenditure in Italian NUTS-2 areas (see tables A1 and A2 in Appendix A).

In our paper we analyse the Italian case for several reasons. First of all, Italy has always been one of the main recipient countries of the EU Structural Funds and it also has a distinct domestic cohesion policy. However, territorial inequalities remain a concern. Indeed, the international literature has often investigated the implementation of cohesion policy in Italy (see, for instance, [Aiello and Pupo, 2012](#); [Giua, 2017](#); [Coppola et al., 2020](#); [Arbolino et al., 2020](#); [Arbolino and Di Caro, 2020](#); [Albanese et al., 2021](#); [Destefanis et al., 2022](#); [Coppola et al., 2023a](#); [Coppola et al., 2023b](#); [Coccorese, 2024](#)) because several factors can reduce its effectiveness. One of these is the displacement of ordinary domestic funds by cohesion ones, a topic that has not been empirically explored enough. This issue concerns the public finances of all European countries, especially in relation to the effectiveness of the EU cohesion policy on economic growth (see, for instance, [Bourdin, 2018](#) and [Di Caro and Fratesi, 2021](#)). Hence, the results for a single country can be useful to evaluate the same issue in other contexts. Indeed, the sectoral analysis of the additionality principle could be extended to other European countries, but, as far as we know, in many countries there may be data limitations on expenditure distinguished by source of funding, sector and region. Of course, we are willing to compare our analysis with similar investigations in different national contexts.

The rest of the paper is organized as follows. [Section 2](#) discusses the implementation of the European cohesion policy and the additionality principle. [Section 3](#) reviews the econometric methods used in the literature to evaluate additionality. [Section 4](#) discusses our empirical strategy while [Section 5](#) summarises the results and [Section 6](#) concludes with some policy implications.

## 2. The additionality principle in cohesion policy

To improve the impact of EU Funds and push the cohesion interventions towards a *place-based policy* ([Barca et al., 2012](#)), the 1988

<sup>1</sup> This was pointed out by the Italian *Agency for territorial cohesion* ([Agenzia per la coesione territoriale, 2021](#)).

Reform (Regulation n. 2052/88) introduced a large set of measures that were later expanded during the subsequent programming periods. They included a better specification of the objectives ([European Parliament and Council, 2006](#)), a strengthening of the monitoring activity by the EU Commission, the identification of authorities in charge of the efficient management and the implementation of Operational Programs (OPs) and the provision of some rules governing Funds' allocation.

These rules referred to the principles of concentration (clustering of resources, objectives and expenditure), programming (a strategic planning procedure is necessary to fulfil European objectives), partnership (involvement of economic agents in all operational phases) and additionality.

The 'additionality' principle states that EU Funds should not be used in place of structural, public or similar, expenditure by member states in recipient regions (art. 15 Regulation EC No. 1083/2006<sup>2</sup>).

Conceptually, the establishment of this last rule would prevent the non-neutrality of cohesion policy on public allocation processes and the reduction of own public expenditure of central government and decentralized entities.

The additionality principle does not solely concern national expenditure but encompasses all public expenditure including investment by regional and local authorities.

Moreover, the heterogeneous characteristics of the Member States should be taken into account. In Italy, the verification of additionality<sup>3</sup> was done at the level of the so-called Enlarged Public Sector (*Settore pubblico allargato*) which included investment by the State, regions, local authorities and public companies.

Up to the 2014–20 programming period, the compliance evaluation took place at the national level. No checks were made on the potential substitution effect at regional and sectoral levels.

Over the years, the assessment of additionality has become an important dimension of the overall evaluation of the effectiveness of cohesion policy.

Officially, the additionality principle was assessed by the European Commission in cooperation with member states at three different stages and only for the convergence regions. At a first stage, the ex-ante evaluation was carried out at the beginning of each programming period. Indeed, as a general rule, the level of domestic expenditure should have been kept at least equal to the level of annual average expenditure in real terms of the previous programming period. At a second stage, three years later, the mid-term evaluation checked whether the annual average expenditure was at least equal to the one that was agreed in the first phase. At this stage, the spending target was checked and revised if necessary. At a third stage, in the last phase, it was assessed whether there had been any differences between the ex-ante agreed level of public expenditure (or revised in mid-term evaluation) and the one calculated ex-post. In presence of discrepancies, the Commission proceeded with financial corrections.

Many official documents of the European Commission showed since the beginning the difficulties in verifying the principle ([Schroeder, 2008](#)). In addition, evidence of not compliance with the criterion were quite common. For instance, at the mid-term evaluation of 2018, the average fixed level of gross capital formation as a percentage of GDP was below the required target for Italy, Bulgaria and Romania ([European Commission, 2022](#)).

Table A2 in Appendix A shows that Italian domestic fiscal policy has been reduced in many sectors between 2009 and 2019. The analysis of whether cohesion funds may have been responsible for substituting domestic investment expenditure have often been debated in public

<sup>2</sup> The legislative sources of the previous programming periods are the Regulation CEE No. 2082/1993, art. 9 and Regulation CE No. 1260/1999, art 11.

<sup>3</sup> The practical details are reported in the Annex A of the Commission methodological guidelines ([European Commission, 2006](#)).

meetings but not always analysed in detail.

Indeed, the new current programming period 2021–27, by eliminating the additionality principle to introduce simplification measures towards a faster managing of the Funds (European Commission, 2018) by-passed the problem at the start. The EU Regulations,<sup>4</sup> which set the general rules underlying Cohesion Funds, did not mention anymore the additionality in the requirements while considering concentration, programming and partnership principles (European Parliament and Council, 2021).

The dismissal of the additionality principle was also related to the diffusion of national fiscal consolidation strategies which followed the Great Recession and the other crises of the last decade. These called for a general need to reduce public investment and for greater flexibility in implementing related decisions. During a crisis, when public investment is lacking, the compliance with the additionality principle was hard to be assured (Cerniglia et al., 2021). In a recession, beyond the additionality rule, even the co-financing requirement could be difficult to fulfil especially at the regional government level (San Juan Mesonada and Sunyer Manteiga, 2021). Furthermore, a lower level of additionality implies lower level of debt and full additionality cannot be a priority when inflation increases and financial markets tighten.

Nevertheless, the analysis of the interaction between cohesion (or other development-designed) policies and ordinary fiscal policy remains an important policy issue as the assessment of a potential trade-off between the two policies.

This has acquired new evidence with the start of Next Generation EU (NGEU) Plans and the use of Recovery and Resilience Facilities (RRF) in many countries. The questioning of the increase of overall public investment as a consequence of the introduction of new fiscal policy instruments has been posed and requires an empirical evaluation (Martinez Mongoy et al., 2022).<sup>5</sup> To quote Corti et al. (2022), “while additionality is a long-time debated issue around the effectiveness of EU cohesion policy, the launch of RRF breathes new life in such a debate”. In addition, scholars started to investigate the issue of substitution of cohesion funds by the new policy instrument (Polverari, 2024). And the additionality principle, in different forms, has been evoked for Covid-19 and NGEU interventions (Olimid and Olimid, 2021; Darvas, 2021).

In order to explore this topic further, in this paper we perform, for the first time, a sectoral panel assessment of cohesion funds’ additionality focusing on the two most recently completed programming periods (2007–13 and 2014–20).

We increase the estimation accuracy by controlling for some variables, potentially suitable to influence sectoral domestic spending and focusing on crucial sectors of cohesion policy (human capital, transport infrastructures, environmental and cultural expenditures) which accounted, as already said, for almost 60 % of the total cohesion spending.

### 3. The compliance with additionality principle: a literature review on empirical evaluation

The debate on the effectiveness of regional policy has always been intense and the EU Funds have often been criticized in many aspects concerning both the policy design and the implementation phase. The most relevant criticisms concerned the risk that cohesion policy could merely act as an income redistribution policy across regions with no real impact on their long-term growth (Barca, 2009). One of the potential causes of cohesion policy ineffectiveness may be a misallocation of the Structural Funds due to non-compliance with the additionality principle.

From a theoretical point of view, the additionality principle has a long-standing conceptual framework. As noted by Del Bo and Sirtori

(2016), its economic motivation is associated with the so-called ‘fly-paper effect’. The *fly-paper effect*<sup>6</sup> has been empirically assessed by Henderson (1968) and Gramlich (1969). These two works are very relevant in policy-making literature since they have demonstrated empirically that if, in a municipal area, per capita income and exogenous grants-in-aid increase by the same amount, the impact on local public spending is different and higher in the second case. Consequently, public expenditure is stimulated more by the enhancement of an exogenous variable<sup>7</sup> rather than by the growth of a variable capturing regional economic conditions. However, it should be emphasized that the fly-paper effect is a *ex-post* empirical evidence. In our specific case, the additionality principle was *ex-ante* imposed by the European policy-maker and the allocative decisions about regionalized domestic fiscal spending might not be in line with this prescription.

In order to eliminate the uncertainty regarding regional policy impact, it is crucial to consider explicitly the so-called policy implementation details, including additionality (Brandtsma et al., 2013).

A related strand of literature investigates the *ex-post* impact assessment of fiscal policy on regional economic growth in combination with EU cohesion policy (Furceri, Mazzola and Pizzuto, 2021) or in contrast with it (Coppola et al., 2020; Destefanis et al., 2022). In detail, Furceri, Mazzola and Pizzuto (2021) demonstrated that, in a sample of OECD countries (1990–2014 time span), expansionary fiscal policy, combined with cohesion spending, encouraged regional resilience to negative country level shocks. Focusing on the Italian regions, Coppola et al. (2020) showed that, during the period 1994–2013, European cohesion funds had a greater impact (as measured in a regional panel convergence model) than both domestic fiscal and national cohesion funds on the growth of regional per capita GDP. These results were confirmed by Destefanis et al. (2022) by contrasting, through a Bayesian RES-PVAR and for the Italian regions, the GDP multipliers of different types of expenditure, during the period 1994–2016. This analysis highlighted strong heterogeneity on the value of the multipliers across the regions and that the EU Funds had the highest multiplier compared to the other national government disbursements.

None of these recent studies, however, have dealt with the analysis of the potential trade-off between cohesion and domestic fiscal policy.

In the scientific empirical literature, the methodology used to measure additionality have often been dependent on data availability. Indeed, data limitations have led to assessments performed at an aggregate level and based on indirect methods. For instance, Varga and in’t Veld (2011) while assessing, through the QUEST model, the potential impact of cohesion expenditure in the programming period 2000–06, admitted that, since the principle of additionality was not always binding, members states were not required to create new budgetary expenses to finance cohesion funds and national reserves were “ear-marked” to co-finance Structural Funds. This means that cohesion funds can be modelled as additional with respect to the benchmark of domestic fiscal expenditure that would have occurred in a counterfactual situation, a circumstance which is not easy to identify.

Psycharis et al. (2020), for the Greek case in the period 2000–2014, also used an indirect method by confronting total gross capital formation at the regional level to the same ratio at a national level since “a pure additional cohesion policy expenditure would increase capital formation in regions that receive more transfers relative to the national level” (p. 206), while a lower ratio of gross fixed capital formation to GDP compared to the national one would detect a no additionality case. The authors found no evidence that investment projects financed by cohesion policy increased regional growth especially for less developed

<sup>6</sup> The author of this coding is Arthur Okun, who commented the empirical works of his colleagues as ‘Money seems sticks where it hits’ (Inman, 2008).

<sup>7</sup> To be precise, in our case, cohesion funds cannot be considered as fully exogenous a-priori since the treatment is endogenous to the regional economic conditions (i.e., per capita GDP).

<sup>4</sup> EU Regulations no. 2021/1057, 2021/1058 and 2021/1060.

<sup>5</sup> In particular, articles 5 and 9 of Regulation (EU) 2021/241 of 12 February 2021.

regions. Since this result was opposite to what happened in the same period for domestic public investment, the authors considered it as indirect evidence of the lack of additionality. Similar conclusions were found in a study on Estonia (Varblane, 2016).

Very few contributions in the past literature have considered explicitly the evaluation of the additionality principle using econometric methodologies.

Ederveen et al. (2006), in an analysis at the country level using dynamic panel data models, concluded that Structural Funds did not explain growth differentials among member states in addition to what is already explained by total (domestic) public investment.

Wostner and Šlander, (2009) used EU-15 country (NUTS-1) data to analyze additionality from 1990 to 2006. Structural domestic spending at all government levels was regressed on European funds and on some control variables. From the fixed effect panel estimation, the authors concluded that the European Structural Funds were mainly additional with no substitution effect. González-Alegre (2012) also employed the EU-15 NUTS-1 sample in the period 1993–2005 by analysing, with panel fixed effect and GMM, the influence of cohesion policy on central, regional, and local government expenditures. The results showed that cohesion policy was associated with an increase in public investments by around 60 %.

At the NUTS-2 level, the panel results by Mohl (2016) concluded that, during the 1982–2006 period and for EU-27 countries, no significantly positive effects of EU payments on public investments occurred.

Del Bo and Sirtori (2016) evaluated public investment substitution and, separately, regional and sectoral displacement effects on the Italian regions for the 1996–2011 period. They adopted a research design focusing on time series methodology (AR (1) with a time trend) but did not combine sectoral and regional detail. Substitution occurs when additional EU resources substitute existing ones while displacement effects concern the case when allocation of sectoral (or regional) shares of domestic funds is distorted by the use of EU Funds in addition to the ones previously used. Their results suggested a strong heterogeneity across regions. Overall, the southern and north-eastern regions had the most pronounced substitution effects while the sectoral displacement effect was negligible.

Szitasióva Nemethová et al., (2014) evaluated the additionality principle with respect to public education improvement programs in Slovakia for the 2006–2010 period at the municipal level (NUTS-3) using a survey on treated municipalities. They analysed whether the recipients decreased their capital spending after receiving European support. The main result was the occurrence of a substitution effect in 10 % of the municipalities. In particular, cities and more developed regions reduced domestic expenditure after support, while less developed areas complied with the additionality principle.

Janský et al. (2016) evaluated additionality on Czech municipalities for the period 2007–2014 by types of expenditure (investments, human resources, and operational costs) and by Operational Programs (OPs). The main OLS results were that, overall, the principle was fulfilled with some heterogeneity among the various OPs.

Cantos-Cantos et al. (2022) investigated whether the transfer of European Regional Development Fund (ERDF) received by Spanish regions in the period 1994–2014 had a contractionary impact on public investment and quantified the impact of ERDF transfer on own financing of regional investment. The conclusion was that there was no additionality and a relevant amount of substitution (-23 %) between regional government funds and ERDF.

Finally, Coppola et al. (2023a) measured the extent of substitutability between European Structural and Investment Funds (ESIF) and other public expenditure in the period 1994–2016 for eighteen Italian regions. They found, for many regions, a relation of substitutability which runs counter to the principle of additionality. No sectoral differences were identified.

Few papers hypothesized a non-linear specification in the relationship between cohesion funds and total public investment. Wostner and

Šlander, (2009) found that, in the case of moderate inflows of European funds, additionality occurred while substitution prevailed after a certain threshold (for inflows greater than 2.33 percent of GDP). Parallely, Becker et al. (2012) found a non-linear effect of lagged impact of Structural Funds treatment on growth.

More recently, Butkus et al. (2020) discovered that the level of additionality may also be different by source of financing (i.e., higher for the Cohesion Fund, lower for ERDF).

Because of data limitations, all the studies that have addressed the empirical assessment of the additionality principle have not considered sectoral heterogeneity in the application of the principle at the regional level. Instead, the sectoral breakdown may highlight potential differences in the degree of additionality of cohesion funds with respect to domestic non-cohesion spending.

Our analysis, through a combined use of two unique databases (*Opencoesione* and Territorial Public Account) available for the Italian public expenditure concerning single project EU interventions and domestic consolidated regional spending is able to test for sectoral differentiation in the additional or substitutional role of cohesion expenditure with respect to national (non-cohesion) fiscal policy. For the Italian case, Coppola et al. (2023b) assessed the ex-post impact of European Structural Funds and national cohesion funds, as well as ordinary current account and capital account domestic expenditure, on the output of four economic sectors (agriculture, industry, construction and services) for the period 1994–2016. The authors constructed the data from the Regionalized Public Expenditure database (*Spesa Statale Regionalizzata*) of the General Accounting Office (*Ragioneria Generale dello Stato*) at the Italian Ministry of Economy and Finance. In this database the annual European cohesion policy expenditure is distinguished by Fund, but it is aggregated, not distinguished by sector. Moreover, the main concern was not the direct evaluation of additionality. Nevertheless, the authors give in the appendix some interesting information on the composition of expenditure by theme of intervention. Instead, in our database, we consider the annual *sectoral* expenditure in cohesion policies, which includes European Structural Funds, national co-financing to Structural Funds and national cohesion funds. Parallely, as dependent variable, we consider the annual *sectoral* ordinary (non-cohesion) expenditure.

## 4. Empirical framework

### 4.1. Data and policy variables

With respect to the existing literature, reviewed in Section 3, we estimate, in a regional panel framework, a direct relationship between cohesion funds and other public expenditure for different sectors in order to verify, in a direct way, the potential substitutability between the two aggregates.

To implement our disaggregated analysis, we needed, on one hand, regional and sectoral breakdown of public expenditure (both for domestic fiscal and cohesion purposes) and, on the other hand, the availability of time-series expenditure data. By combining two different data sources, in the Italian case it is possible to overcome this limitation. For the information concerning cohesion policy expenditure we rely on *Opencoesione* (OC), a database managed by the Department of Cohesion Policies (*Dipartimento per le politiche di coesione*) in collaboration with the National Agency for Territorial Cohesion (*Agenzia per la coesione territoriale*) and the General Accounting Office (*Ragioneria Generale dello Stato*). This database contains information on expenditure for the two most recent (completed) programming periods (2007–13 and 2014–20).

In OC each project is monitored by location, sector, investment typology, state of advancement of expenditure flows and project execution, starting and completion years.

Data on Italian domestic spending at the regional level are extracted from another database on territorial public accounts (*Conti pubblici territoriali* or CPT), a database which includes the regionalized spending by all public administrations (as well as by national or local public

enterprises). In detail, this database traces the overall expenditure flows of public administrations towards NUTS-2 territories. The payments are recorded according to the cash criterion ('actual realization' of the payments).<sup>8</sup>

Public spending is classified by function. The consolidation method avoids the occurrence of duplications by excluding the transfers from a public administration to another one and concentrating on 'final expenditures' only. Public spending is split into 29 sectors whose definition matches the sectoral classification in public administrations' budgets (*Agenzia per la coesione territoriale*, 2007).

The CPT was originally built to fulfil the European additionality constraint (*Agenzia per la coesione territoriale*, 2007). Initially, the compliance was proved with the ex-ante additionality table included in the national Community Support Framework (*Quadro Comunitario di Sostegno* or QCS).

CPT and OC databases are different in terms of data aggregation methods and sectoral definitions. Therefore, the combined use requires a preliminary alignment exercise.

In this work we refer to some recent reports by the *National Agency for Territorial Cohesion* (*Agenzia per la coesione territoriale*, 2021) matching 29 CPT sectors with the sectoral domain of OC in order to separate from the overall CPT expenditures those having cohesion purposes.

In detail, the *Agency* selects all the projects in the OC sector which appears, at a first stage, the most compatible with the counterpart CPT sector. Secondly, as a check of the first stage, they carry out a textual search in the projects titles to exclude from a sector the projects belonging to another CPT sector. Finally, the *Agency* runs a keyword-based text search tracing all OC projects belonging to the corresponding CPT sector.

As for the payments to the beneficiary, the *Agency* attributes a payment tranche to the year of the monetary disbursement.

From the information in the *Agency* publications, we calculated the raw data on cohesion policies payments, in order to separate domestic non cohesion fiscal policy from cohesion resources. These include European cohesion policy, national co-financing and national cohesion funds.

By combining the two sources in a methodologically sound way, we are able to discriminate between the two types of policy for each sectoral and regional unit of analysis.

In Italy, the mitigation of inter-regional disparities has also been a strong policy objective by the national government.<sup>9</sup> Indeed, the Italian government contributes to reinforce the European cohesion policy with the (binding) national (and, to a lesser extent, regional) co-financing to EU Funds through a specific national Fund.<sup>10</sup> The co-financing share

<sup>8</sup> To regionalize the expenditure, the CPT database attributes the flow to the region where the public intervention is localized following a bottom-up process based on the reconstruction of all aggregates (*Agenzia per la coesione territoriale*, 2007). For the spending flows linked to the production of goods and services (and to the increase in the stock of non-financial capital), the regionalization is carried out on the basis of the physical location of the employed production factors. Instead, for the financial flows, the regionalization is linked to the site of the beneficiary.

<sup>9</sup> Indeed, economic and social cohesion has a legal foundation in Italy. The two legislative references are the article 119, paragraph 5 of the Italian Constitution and the Article 174 of the Treaty on the Functioning of the European Union.

<sup>10</sup> This fund is called *Fondo di rotazione per l'attuazione delle politiche comunitarie*.

depends on the level of regional development.<sup>11</sup>

In addition, the Italian government implements its regional policy with a specific Development and Cohesion Fund (*Fondo di sviluppo e coesione* or FSC) established with the 2003 budget law.<sup>12</sup> The peculiarity of the FSC is its multi-annual nature since it has a programming period that coincides with the European one.

Two additional funds, specifically aimed at territorial cohesion, are the Action and Cohesion Plan (*Piano di azione e di coesione* or PAC), in the 2007–13 period and the Complementary Operational Plan (*Piano Operativo Complementare* or POC), in the 2014–20 period.

The existence of a specific domestic cohesion policy calls for the extension of the additionality evaluation to comprehensive cohesion resources (i.e., including both European and national). This extension is taken into account in the empirical analysis which follows.

#### 4.2. Model specification

Our objective is to assess whether the allocation of Structural Funds and Italian cohesion policy may bias policy choices on domestic fiscal spending allocation at the sectoral level.

We implement, for different sectors, a regional panel model in which public expenditure net of cohesion funds is explained by the cohesion policy and by a set of regional and sectoral control variables suitable for explaining the sectoral domestic decisions. We chose a regional panel approach at the sectoral level since the relationship between cohesion policy and ordinary domestic one may vary over time reflecting changes in economic conditions and sectoral priorities. Without considering the potential evolutions of this relationship over the EU programming period, and assuming that the spending level remains as ex-ante planned, we could leave out the adjustments across the programming period concerning how the resources are allocated. Linked to this point, *Cantos-Cantos et al. (2022)* highlighted that the ex-ante allocation restrictions imposed by the European Commission are not binding. On the contrary, in practice, the regions have a certain level of flexibility to manage funds according to the needs over the programming period. This has been especially the case in the 2014–20 period.

We focus on five sectors of public spending, i.e., *Education, Road Infrastructure, Other Transport Infrastructure, Environment* and *Culture*. *Table 1* details the typology of expenditure included in each sector for domestic fiscal policy.

The period under scrutiny spans from 2009 to 2018<sup>13</sup> and we consider 20 NUTS-2 level Italian regions.<sup>14</sup>

Following *González-Alegre (2015)*, the dependent variable is the regionalised annual public expenditure net of cohesion policies, in percentage of regional GDP. The main explanatory variable is the cohesion policy annual payments as defined in *Section 4.1*, also expressed in percentage of regional GDP.

*Table A3* of the Appendix A contains the descriptive statistics of the two policy variables for each sector.

Our model follows the equation:

$$OP_{it} = \beta_0 + \beta_1 CP_{it-1} + \beta_2 RD_{it-1} + \beta_3 SV_{it-1} + v_{it} \quad (1)$$

<sup>11</sup> For the 2007–13 programming period, the co-financing was at least 25 % for the Convergence objective regions. For the Competitiveness objective regions, the national co-financing had to be no less than 50 %. Instead, in the 2014–20 programming period, the national co-financing varied from 50 % to 85 % depending on the category of the region, the priority axis and the specific structural Fund.

<sup>12</sup> The initial name was *Fondo per le aree sottoutilizzate* (FAS).

<sup>13</sup> For the *Environment* and *Culture* sectors the last available year is 2019 while for the *Road Infrastructure* sector is 2017).

<sup>14</sup> Though most of the regional databases in Italy allows to distinguish between the two autonomous provinces of Trento and Bolzano inside the Trentino Alto Adige region, this breakdown was not available for the databases used in our analysis. So, we combined the two provinces into one region.

**Table 1**  
Definition of sectors and related expenditure typology.

Sector of analysis	Typology of expenditure
Education	<ul style="list-style-type: none"> <li>- Administration and functioning of public schools and university (net of research)</li> <li>- School and university building</li> <li>- Ancillary educational services</li> </ul>
Road Infrastructure	<ul style="list-style-type: none"> <li>- Support to the right to education and educational trips</li> <li>- Construction, use and maintenance of street and highways</li> <li>- Installation of bridges, tunnels, and parking</li> <li>- Public lighting</li> <li>- Management of licensing activity</li> </ul>
Other Transport Infrastructure	<ul style="list-style-type: none"> <li>- Construction, use and maintenance of all transport infrastructure except streets and highways</li> <li>- Local public transport (including local public transport by road)</li> <li>- Management of licensing activity</li> </ul>
Environment	<ul style="list-style-type: none"> <li>- Land and biodiversity protection, pollution reduction</li> <li>- Forestry support; supervision, control, prevention and repression of environmental disasters</li> <li>- Assessment of the environmental impact of plans and projects</li> <li>- Management and protection of natural parks and public green areas</li> <li>- Management and monitoring of environmental policies</li> </ul>
Culture	<ul style="list-style-type: none"> <li>- Protection of artistic and cultural heritage</li> <li>- Museums, libraries, art galleries and cultural centers</li> <li>- Cinemas, theatres, musical activities and other recreational activities including their diffusion</li> <li>- Support to gardens and zoological museums</li> <li>- Leisure initiatives</li> </ul>

Source: Agenzia per la coesione territoriale, (2007).

$$v_{it} = u_{it} + a_i; i = 1, \dots, N; t = 1, \dots, T$$

where, *i* indicates regions and *t* refers to years.

$OP_{it}$  is the ordinary domestic fiscal policy which includes the comprehensive regionalized public expenditure net of cohesion resources.  $CP_{it}$  is the cohesion policy variable including the European Structural Funds, in particular, the European Regional Development Fund and the European Social Fund; the national cohesion ones, in particular, the Cohesion and Development Fund (*Fondo di Sviluppo e Coesione*), the Action and Cohesion Plan (*Piano di Azione e Coesione*), and the Complementary Operational Plan (*Piano Operativo Complementare*); the national co-financing related to EU funds (Revolving Fund, *Fondo per l'Attuazione delle Politiche Comunitarie*). Since data on domestic fiscal policy and cohesion policy are expressed in current prices, we divided both variables by nominal GDP to control for inflation. As for the other variables,  $RD_{it}$  is a regional development variable<sup>15</sup> included in all the sectoral regressions,  $SV$  is a matrix of controls of sectoral/regional endowments which represent the indicators used for allocating national public spending to a specific sector/region and  $v_{it}$  is the composite error including the zero-mean random error term ( $u_{it}$ ) and the regional-specific effect ( $a_i$ ).

To test the robustness of the results to the change in the sectoral variable, we estimated different model specifications which vary according to the chosen endowment indicator.<sup>16</sup>

For *Education*, we considered three endowment variables, capturing the sectoral dimension in a region in terms of number of students, classes and schools at both primary and secondary education levels. The implicit assumption is that the increase in the regional endowment, as previously defined, would increase the maintenance costs of school infrastructure and of all the other related spending financed by domestic

<sup>15</sup> In the estimates we used the logarithm of the real per capita gross domestic product.

<sup>16</sup> Our estimations for each sector were not affected by severe multicollinearity.

fiscal policy.

For the *Road Infrastructure* sector, we used the length in kilometers of the provincial and regional roads or, alternatively, the number of road accidents.

For the *Other Transport Infrastructure* sector, we considered a railway<sup>17</sup> infrastructural index and two indicators representing the demand and the supply of local public transportation (LPT).

For the *Environment* sector, we used the total forest area, the Special Protection Zones and the Sites of Community Importance.

For the *Culture* sector, we considered the number of entertainment venues and museums, libraries, theatres and concerts.

All data were extracted from Italian National Institute of Statistics (ISTAT) databases. See table A4 in the Appendix A for a complete description of the sectoral variables' definition.

The sector-by-sector panel framework described above, better fits our aim of investigating the potential sectoral heterogeneity in regional policy additionality. Specifically, we seek to estimate the direct impact of the cohesion variable for each sector while accounting for explanatory variables that differ across sectors. A tri-dimensional panel framework (time-region-sector) might have the advantage of increasing the sample size but would be justifiable only in the case in which we can assume independence of the error terms across sectors which is not the case if sectoral interconnections occur. In that case, the estimation of the sectoral coefficients of the cohesion policy (the goal of our analysis) would require the inclusion of an interaction between the sectoral fixed effects and the cohesion variable which may lead to multicollinearity problems.

#### 4.3. The endogeneity issue

The cohesion funds spent annually could be influenced by contemporaneous domestic fiscal policy. For instance, the national or regional governments can use cohesion funds to strengthen their own investment policies by aligning these funds to national (or regional) priorities. In addition, the two policies may have the same determinants. Thus, to reduce reverse causality, we inserted cohesion policy variable one-period delayed. Regional and sectoral control variables were also included lagged by one period. However, the exogeneity assumption of the cohesion variable should be verified in detail.

Nevertheless, though it is true that the allocation of Structural Funds is predetermined and independent from measures pertaining to individual countries, the allocation within the budget period (included the  $n + 2$  or  $n + 3$  extensions) is not fully endogenous because it is conditional on specific flows to be approved (Staehr and Urke, 2022). Indeed, as mentioned before, Cantos-Cantos et al. (2022) observed that the restrictions imposed by the EU for allocating funds are not binding because regions can receive the money for a long period of time during which they are free to distribute the aid as they like and the grant is not linked to a specific project. Therefore, the aid is received like a lump-sum transfer and it is likely to substitute own funds for European funds to undertake public investment by allocating funds to other needs. This creates a potential dependence of cohesion funds on regional and national public investment.

Therefore, we addressed the potential endogeneity of cohesion policy by employing FE-2SLS and GMM approaches.

The application of the 2SLS procedure requires a vector of instruments  $Z$  not included in our main Eq. (1) which satisfy the inclusion and the exclusion restrictions (relevance and exogeneity, respectively). The first condition states that each instrument must be highly correlated with the potential endogenous variable. The search for valid instruments should be guided by institutional knowledge and own ideas about the processes determining the variable of interest (Angrist and Pischke, 2009). Moreover, we checked the validity through the *F*-statistic of the

<sup>17</sup> We cannot use airport and port indicators given the heterogeneity in the transportation mode among the Italian regions.

first-stage regression obtained by regressing the cohesion policy variable on each potential instrument and on all the other exogenous variables.

The second condition claims that each instrument must not be in a causal relation with the dependent variable. To test instruments exogeneity, we performed the Hansen and Sargan test, namely  $J = nR^2 \sim \chi_q^2$ , robust to heteroskedasticity.

Adopting a policy-driven approach to select the instrumental variables suitable for our case, we used as instruments the regional indicators which are taken into account in the design of Regional Operational Programs (ROPs). We employed sector-specific indicators because they are actually used to guide the sectoral allocation of regional policy. In this sense they can be considered as potential instruments for cohesion policy disbursement at regional/sector level. Thus, our instruments for regional policy, that differ from the sectoral variable set (SV) included in the Eq. (1), are context indicators extracted from a specific ISTAT database on regional indicators relevant for cohesion policies used in the ROPs' design (*Banca dati indicatori territoriali per le politiche di sviluppo*) (see Table B1 in Appendix B). This should conceptually ensure a high correlation between regional policy and the sectoral context indicators used (inclusion restriction<sup>18</sup>).

We used the one-year lag of the instruments with respect to cohesion policy since these indicators are indeed predetermined for cohesion policy decisions.

For robustness, we also considered a delay of three years with respect to the cohesion policy variable to take into account a longer lag between decision and policy operationalization. Therefore, the instruments were lagged two years ( $Z_{t-2}$ ) and four years for robustness ( $Z_{t-4}$ ) with respect to the domestic fiscal policy. Beside the conceptual motivation, the delay of instruments has also an econometric basis. It could make the instruments more exogenous with respect to the dependent variable, since ordinary domestic fiscal and cohesion policies follow different programming rules. Therefore, it is likely that a delay of at least of two periods for the instruments with respect to domestic fiscal policy makes them even less related to it. This requirement is crucial when only one instrument is used to test the cohesion endogeneity since, as known, the exclusion restriction with a single instrument is not econometrically testable.

From the economic point of view, these indicators, especially when calculated sufficiently in advance, can be considered exogenous with respect to domestic expenditures (net of cohesion funds) since these mostly concern the allocation of national and regional budget to specific sectors in order to satisfy "ordinary" needs. In the literature we also found examples of other possible instruments with no regional and sectoral specificity.<sup>19</sup> In our paper we preferred to use regionally and sectorally specific instrumental variables and proceeded to a validation of them through testing inclusion and exclusion restrictions.

We selected two instruments for each sector as follows. For *Education*: junior high school and school drop-out; for *Road Infrastructure*:

openness to international trade and labour productivity<sup>20</sup>; for *Other Transport Infrastructure*: openness to international trade and labour productivity; for *Environment*: labor productivity and landfill waste disposal; for *Culture*: labour productivity and per capita expenditure in entertainment. The detailed definition of the instruments, and the *F*-test and *J*-test are reported in Tables B1 and B2, respectively, contained in Appendix B. According to Table B2, in all sectors the instruments are highly correlated with the cohesion variable (see the *F*-test for relevance) and in all cases they are exogenous to domestic fiscal policy since we do not reject the null hypothesis of the *J*-test. Therefore, the instruments in each sector, overcame both constraints and can be used to ascertain whether FE-OLS estimators are unbiased, or FE-2SLS estimators should be preferred.

As a second step, our strategy proceeded by examining the cohesion variable endogeneity through the Durbin-Wu-Hausman (DWH) test to ascertain whether our model (1) would be estimated by FE-2SLS or by FE-OLS techniques. The test works as described in technical Appendix B which contains the results in Tables B3-B7.

According to these results, we conclude that the cohesion variable is exogenous at 5 % significance level for *Education*, *Road Infrastructure*, *Other Transport Infrastructure* and *Environment* regardless of the instrument included and of the delay considered. Therefore, for these four sectors, the implementation of FE-2SLS was discarded and we proceeded with the estimation through FE-OLS as baseline methodology. However, for robustness, we reported also the FE-2SLS estimations.

In the case of the cultural sector (Table B7), cohesion policy appears not always exogenous<sup>21</sup> thus we considered as baseline results those obtained by both FE-OLS and FE-2SLS approaches.

To further address the endogeneity issue, we employed also an internal instruments framework through GMM methodology with Arellano and Bond (1991)<sup>22</sup> and Blundell and Bond (1998)<sup>23</sup> estimators,<sup>24</sup> including the one-period lag of the dependent variable. Beyond the endogeneity issue, the dynamic specification was embraced also to take into account that sectoral domestic spending can follow an autoregressive process, thus avoiding an omitted variable bias in the estimation of cohesion variable coefficient.<sup>25</sup> We expected that the results were not so different since endogeneity was overall not an issue in the baseline estimations.

<sup>20</sup> We used sectoral regional labour productivity because, during the programming phase, cohesion funds should be mainly directed towards regions and sectors lagging behind in labour productivity in order to foster long-term growth and regional convergence. Indeed, supporting productivity growth has always been strategic for the European Commission in the context of cohesion policy as highlighted recently, for instance, by the 9th Report on Economic, Social and Territorial Cohesion (European Commission, 2024) and similar positions were also expressed in the previous Reports. Sectoral labour productivity should conceptually capture the effects of cohesion policy without being directly related in a causal relationship with the dependent variable. Moreover, we evaluated empirically the inclusion and exclusion restrictions.

<sup>21</sup> The cases for which exogeneity is rejected occur when instrumenting cohesion policy with *Per capita expenditure in entertainment* at  $t-2$  and when using both instruments at  $t-2$ , in model specification (a).

<sup>22</sup> Differenced equation with lagged levels of the variables used to form GMM-type instruments.

<sup>23</sup> Level equation with lagged differences used as instruments, in addition to the moment conditions of lagged levels of the variables used as instruments for the differenced equation.

<sup>24</sup> We must use a word of caution for the application of these estimation method that are more suitable in the case of large samples.

<sup>25</sup> The lagged dependent variable was not included when the estimation method was FE-OLS due to the well-known estimation bias arising, for instance, from the violation of the strict exogeneity assumption (Nickell, 1981; Arellano, 2003).

<sup>18</sup> In addition, the inclusion restriction was econometrically checked through the *F*-test reported in Table B2 of Appendix B.

<sup>19</sup> Dichotomous dummies related to the years when enlargement of EU occurred or ordered dummies following the chronological order of the years inside the programming period were used, for instance, by Cantos-Cantos et al. (2022).

## 5. Empirical results and discussion

### 5.1. Baseline results

Following the results of the previous section, we estimated model (1) for most sectors using FE-OLS. Individual (regional) fixed effects are robust to potential misspecification and they produce unbiased estimated coefficients also with potential omitted time-invariant characteristics since they control for regional-specific factors (Wooldridge, 2009). The standard errors were adjusted through the Huber and White correction (robust Huber/White standard errors). The results of the model estimations are presented, for each sector, in Tables 2–6.

The analysis shows that there is a strong heterogeneity in the measurement of cohesion policy additionality across sectors.

In the *Education* sector, cohesion policy seems to substitute ordinary policy as the estimated FE-OLS coefficient is negative and statistically significant (Table 2). The decrease in domestic spending due to cohesion policy is more than proportional.

In addition, from the comparison between the estimation of the different specifications inside each table, we may conclude that, in all sectors, the coefficients of the policy variable are robust to the choice of the sectoral endowment variable.

From Table 3 we can conclude that also in the *Environment* sector there appears to be a significant effect towards substitution.

Moving to the transportation dimension, the results are in favor of additionality. For the *Road Infrastructure* sector (Table 4), the sign is positive but not statistically significant, attesting a substantial additionality of cohesion policy with respect to the *ordinary* domestic fiscal policy allocation.

The cohesion funds appear to clearly enhance domestic fiscal policy for the *Non-Road Transportation* sector (Table 5).

As for the other explanatory variables, per capita income (selected as a proxy of the general economic condition of the regional economy) is always positively related to domestic public spending. According to the estimates, the level of regional development affects the dimension of sectoral domestic public expenditure in a pro-cyclical fashion. This result is consistent with the Wagner Law (Wagner, 1890) which affirms that the higher the level of economic development, the greater the level of public expenditure required. Indeed, one of the versions of Wagner Law assumes that there is a positive relationship between public expenditure divided by GDP and the per capita GDP and that the causal link goes from per capita income to public expenditure.

As for the sectoral variables, the relation between them and domestic public investment policy should be positive since these variables capture sectoral endowments.

In the *Education* sector, domestic spending increases following the increase any of the three sectoral variables considered since operating costs grow with size.

**Table 2**  
Effects of Cohesion Policy on Domestic Fiscal Policy in *Education*. FE-OLS baseline results.

Variables / Models	(a)	(b)	(c)
Cohesion Policy	-2.3373 *** (-4.04)	-2.3881 *** (-4.13)	-2.3619 *** (-3.88)
Real per capita GDP	1.6599 ** (2.27)	1.5744 * (2.05)	1.6372 ** (2.18)
Students	0.0139 * (1.74)		
Classes		0.2456 * (1.91)	
Schools			1.4574 ** (2.38)
N.obs	200	200	200
R <sup>2</sup>	0.4183	0.4250	0.4085

Notes: Robust *t*-test in parentheses.

\*\*\*: p-value < 0.01, \*\*: p-value < 0.05, \*: p-value < 0.10.

**Table 3**  
Effects of Cohesion Policy on Domestic Fiscal Policy in *Environment*. FE-OLS baseline results.

Variables / Models	(a)	(b)	(c)
Cohesion Policy	-0.5074 ** (-2.79)	-0.4292 * (-2.34)	-0.3758 ** (-2.09)
Real per capita GDP	0.6606 ** (2.23)	0.5213 * (1.87)	0.6092 ** (2.22)
Forests	0.0574 *** (2.92)		
Special Protection Zones		0.0181 *** (4.31)	
Site of Community Importance			0.0161 ** (2.83)
N.obs	220	220	220
R <sup>2</sup>	0.1320	0.1855	0.1733

Notes: Robust *t*-test in parentheses. \*\*\*: p-value < 0.01,

\*\*: p-value < 0.05, \*: p-value < 0.10.

**Table 4**  
Effects of Cohesion Policy on Domestic Fiscal Policy in *Road Infrastructure*. FE-OLS baseline results.

Variables / Models	(a)	(b)
Cohesion Policy	4.3746 (0.94)	4.5536 (0.98)
Real per capita GDP	3.5306 *** (3.16)	2.7527 * (2.07)
Street endowment	0.1097 ** (2.45)	
Road accidents		0.1200 (1.62)
N.obs	180	180
R <sup>2</sup>	0.2435	0.2380

Notes: Robust *t*-test in parentheses.

\*\*\*: p-value < 0.01, \*\*: p-value < 0.05, \*: p-value < 0.10.

**Table 5**  
Effects of Cohesion Policy on Domestic Fiscal Policy in *Other Transport Infrastructure*. FE-OLS baseline results.

Variables / Models	(a)	(b)	(c)
Cohesion Policy	0.9208 (1.41)	1.0590 * (1.94)	1.2157 * (1.90)
Real per capita GDP	1.1092 * (1.73)	1.1224 * (1.85)	1.0114 (1.64)
Railway index	0.1045 ** (2.25)		
LPT (demand)		0.0014 (1.24)	
LPT (supply)			0.1567 * (1.80)
N.obs	200	200	200
R <sup>2</sup>	0.1868	0.1436	0.1699

Notes: Robust *t*-test in parentheses.

\*\*\*: p-value < 0.01, \*\*: p-value < 0.05, \*: p-value < 0.10.

In the *Environment* sectors, each endowment variable is consistently positive and strongly significant demonstrating that domestic fiscal spending grows following the growth of the sectoral dimension.

In the *Road Infrastructures* and *Other Transport Infrastructure* sectors, all the endowment variables are consistently positive and mostly statistically significant. This is because the more developed is the existing transport network, the higher will be the maintenance costs required and the related non cohesion domestic public investment expenditure.

Turning to the cultural sector (Table 6), for which exogeneity depends on the instruments used, both FE-OLS and FE-2SLS results display

**Table 6**  
Effects of Cohesion Policy on Domestic Fiscal Policy in *Culture*. FE-OLS and FE-2SLS baseline results.

Variables / Models	(a) FE-OLS	(b) FE-OLS	(a)	(a)
			FE-2SLS (Z1 <sup>c</sup> and Z2 <sup>c</sup> ) <sub>t-2</sub>	FE-2SLS (Z1 <sup>c</sup> and Z2 <sup>c</sup> ) <sub>t</sub>
Cohesion Policy	-0.2657 (-1.10)	-0.2259 (-1.05)	-8.9924 (-0.62)	-10.5042 (-0.87)
Real per capita GDP	2.2964 *** (5.51)	1.9107 *** (5.52)	-0.6791 (-0.14)	-1.1946 (-0.29)
Entertainment venues	0.0072 *** (3.66)		0.0104 * (1.73)	0.0109 * (1.91)
Museum		0.0023 *** (4.09)		
N.obs	220	220	220	220
R <sup>2</sup>	0.2195	0.2240		

Notes: Robust *t*-test in parentheses. \*\*\* : p-value < 0.01, \*\* : p-value < 0.05, \* : p-value < 0.10.

The Z1 instrument is labor productivity while Z2 instrument is per capita expenditure in entertainment.

consistently a negative coefficient for the cohesion variables although with non-significant coefficients. In this case, we conclude that cohesion policy does not affect ordinary domestic spending (neutral effect).<sup>26</sup> In addition, all other explanatory variables show significant coefficients with the expected signs.

To summarize the most relevant findings, the influence of regional cohesion policy on ordinary domestic fiscal one is different according to the sector of expenditure. A clear crowding-out effect emerges in the *Education* and *Environment* sectors. In the *Other Transport Infrastructure* and *Road Infrastructure* there seems to be an additional effect of cohesion funds. In the cultural sector there is no evidence of substitution effect since the coefficient, while negative, is not statistically significant.<sup>27</sup>

These results may have a possible explanation looking at the actual implementation of the policy.

The findings for *Education* sectors may be linked to the management of human capital policies. Indeed, these policies are mostly governed by local administrations (such as regions, provinces and municipalities) which in the past years have received more funds from EU policy. This has probably induced regional and local policymakers or even national ones to reduce the flow of (non-cohesion) domestic fiscal expenditures.

By contrast, it is usual, at least in Italy, that the infrastructure investments in transportation are carried out in lots. The additionality may then refer to the fact that, for instance, for a railway or highway track lot, after obtaining European funding, the completion of the public work is later financed through specific national programs, i.e., in Italy, the National Transport Plan (*Piano Nazionale Trasporti*) and the Regional Transport Plans (*Piani Regionali Trasporti*).

Another possible explanation may be the different nature of public spending in human capital and transportation. Indeed, the resources to transportations sectors may have been more oriented to capital expenditure while, on the contrary, human capital policies mainly support interventions to improve educational attainments and job opportunities (see, for instance, [Table 1](#)) which may be financed mostly by current expenditures.

Moving to the environmental policies, they have received increasing attention in recent years and cohesion funds are one of the channels through which they have been strengthened. The (Italian) National Strategic Framework (*Quadro Strategico Nazionale*) for Regional

<sup>26</sup> Strictly speaking, in this case we cannot exclude additionality because cohesion funds do not alter domestic fiscal expenditure

<sup>27</sup> By adding time fixed effects for robustness, not reported for brevity, the results were generally confirmed. Furthermore, we also tried to estimate the sectoral models by including the quadratic cohesion policy term, but the non-linear specification was generally rejected.

**Table 7**  
Sectoral coefficients of Cohesion Policy. FE-2SLS robustness checks.

Sectors/Models	(a)	(b)	(c)
<i>Education</i>	-6.5963 *** (-3.02)	-6.8885 *** (-3.03)	-6.9635 *** (-2.97)
<i>Environment</i>	-2.9049 ** (-2.53)	-2.4225 ** (-2.16)	-2.7747 * (-1.93)
<i>Road Infrastructure</i>	173.3072 (0.13)	421.5554 (0.06)	
<i>Other Transport Infrastructure</i>	4.7897 (0.84)	5.4314 (0.94)	1.9100 (0.46)
<i>Culture</i>	-7.5745 (-1.05)	-9.0260 (-1.15)	

Notes: Robust *t*-test in parentheses. \*\*\* : p-value < 0.01, \*\* : p-value < 0.05, \* : p-value < 0.10.

For each sector, model (Eq. 1) changes its specification according to the sectoral control variable as follows. For *Education*, (a): students, (b): classes, (c): schools; for *Road Infrastructure*, (a): roads endowment, (b): road accidents; for *Other Transport Infrastructure*, (a): railway, (b): LPT (demand), (c): LPT (supply); for *Environment*, (a): total forest area, (b): Special Protection Zones, (c): Sites of Community Importance; for *Culture*, (a): entertainment venues (cinemas, theatres, concerts, sports venues, dance venues, exhibitions), (b): museums, libraries, theaters and concerts. In these estimations, the instruments for cohesion variable are calculated at *t*-4. Instruments used are: for *Education*: school dropout; for *Environment*: landfill waste disposal; for *Road Infrastructure* and *Other Transport Infrastructure*: openness to international trade; for *Culture*: per capita expenditure in entertainment.

Development Policy 2007–2013 considered ‘*Environment*’ as the third priority (after human capital policies and research and innovation). The Partnership Agreement 2014–20 also highlighted the importance of environmental interventions for both European and national cohesion policy. Furthermore, the *framework of competences* in the field of environment assigns a leading role to the regions and local authorities ([Department of Cohesion Policy, 2007](#); [Department of Cohesion Policy, 2017](#)). Therefore, the considerable amount of cohesion funds may have oriented the governments to channel environmental interventions via cohesion funds with the consequence of lowering ordinary domestic spending in this sector and reallocating it to other priorities.

As for the cultural sector, Italy is in a critical position compared to other European countries. According to the Government Finance Statistics of Eurostat it emerges that Italy is one of the European countries with the lowest public spending to GDP ratio on culture. The political debate on this point is intense and amplified by the media. Given the attention of public opinion, it would be even more inappropriate if the cohesion funds were used in place of ordinary funds in this sector. Indeed, according to our results, the effect of cohesion policy on ordinary one is negative but not significant, not suggesting a clear evidence of a substitution effect.

## 5.2. Robustness checks

For robustness check, we display, in [Table 7](#), the estimations of the cohesion policy coefficients through 2SLS methodology. For brevity, we report the results carried out by instrumenting cohesion variable with the conceptually strongest instruments, calculated at *t*-4 because, as we explained in [Section 4.3](#), a longer lag of the instruments should make them more exogenous with respect to the dependent variable.

In all the sectors, the signs of the estimated FE-2SLS coefficients are consistent with those of FE-OLS. The non-significance of the coefficients in *Other Transport Infrastructure* sector can be associated to the lower efficiency of the 2SLS estimator compared to the OLS one when endogeneity is not an issue ([Wooldridge, 2009](#)).

For further robustness checks, we estimated our sectoral models also

by applying an internal instruments approach by Arellano and Bond (GMM-AB) and Blundell and Bond (GMM-BB<sup>28</sup>) system-GMM including the one-period lag of the dependent variable.

We show, in Table 8, the coefficient of cohesion policy in the GMM-AB estimation for each sector. Our results are almost all confirmed, i.e., the substitution effect in the *Education* sector, a negative and not significant effect in the cultural sector, an additional effect in the *Other Transport Infrastructure* and in the *Road Infrastructure* sector. In the environmental sector, the strong substitution effect found through FE-OLS methodology is weakened by applying GMM and the coefficient is not statistically different from zero.

The limited difference of the results of GMM estimation from the ones derived from the static panel framework is taken as evidence of the robustness of our findings with respect to the parameters of interest (see on this point, in the cohesion policy additionality context, Ederveen et al., 2006 or San Juan Mesonada and Sunyer Manteiga, 2021).

Finally, a worthwhile issue is the potential differences in the compliance with the additionality principle among single regions, in particular, between the ‘convergence’ and the ‘competitiveness’ regions. The main problem to evaluate this issue in our case is that the sample size is not particularly large. This does not make easy to estimate cohesion variable coefficients specific to groups of regions. In addition, we could not include the interaction between the cohesion variable and the ‘convergence’ regions due to multicollinearity issue. Moreover, the partition of the sample between convergence (including in this also phasing-in and phasing-out) and competitiveness regions and the estimation of separate regressions makes less reliable the results of the two different groups due to their not direct comparability in terms of different sample size.

To better appreciate the heterogeneity between regions in the impact of cohesion policy on domestic spending, we estimated specific cohesion policy coefficients for each region *i* by augmenting the model specification (1) with an interaction term between the cohesion variable and a dummy variable assuming a value equal to one for region *i* and zero otherwise. We performed the regressions considering one region at a time. The rest of the model specification remained the same.

Thus, for each sector, we estimated twenty specifications, each containing the single region *i* dummy interacted with the cohesion variable. We report in Appendix C (Tables C1-C3) the estimated coefficients of the cohesion variable alone and of the interaction of this variable with the regional dummy. Their sum (reported in the tables) represents the total effect of cohesion policy in the specific region *i*.

This analysis substantially confirms the global displacement effect

**Table 8**  
Sectoral coefficients of Cohesion Policy. GMM-AB robustness checks.

Sectors/Models	(a)	(b)	(c)
<i>Education</i> (N.obs = 160)	-1.2420 *** (-5.82)	-1.2269 *** (-5.64)	-1.2527 *** (-5.97)
<i>Environment</i> (N.obs = 180)	0.1478 (0.37)	0.1467 (0.37)	0.1600 (0.41)
<i>Road Infrastructure</i> (N.obs = 140)	1.7623 (1.17)	2.1787 (1.41)	
<i>Other Transport Infrastructure</i> (N.obs = 160)	1.4570 (1.64)	1.6567 ** (2.05)	1.7404 ** (2.12)
<i>Culture</i> (N.obs = 180)	-0.2006 (-1.00)	-0.2291 (-1.06)	

Notes: Robust t-test in parentheses. \*\*\* : p-value < 0.01, \*\* : p-value < 0.05, \* : p-value < 0.10.

For each sector, model (Eq. 1) changes its specification according to the sectoral control variable, see notes in Table 7.

<sup>28</sup> Not reported for brevity. The results can be extended.

found in the *Education* sector. Indeed, for most regions the interaction variable is negative and for half of the regions it is statistically significant. The total effect is negative in all cases except one. Regional heterogeneity is more visible in the environmental sector where in some (few) cases the interaction variable is positive and statistically significant. The global effect remains mostly negative. Relevant regional heterogeneity is found in the *Road Infrastructure*, *Other Transport Infrastructure* and *Culture* sectors. In any case, the investigation of the total effect confirms the overall previous results, especially for convergence regions.

The regional dummies capture the effect of differentiated institutional quality, administrative features, any other unobserved characteristic as well as region-specific needs and priorities in the management and spending of cohesion policy funds in direct relation to domestic spending.

This analysis reveals that regions do not exhibit uniform behaviour across sectors, highlighting both regional and sectoral heterogeneity, but also potential re-programming of funds from one spending area to another. Indeed, in some regions, the displacement in one sector may be due to the re-allocation of domestic funds to other sectors because of the presence of cohesion funds in that sector. The opposite case, in which cohesion policy exerts a growth-enhancing effect on domestic spending in a specific region, indicates an alignment of priorities and financial effort of domestic public expenditure with those of cohesion policy.

## 6. Conclusions

This paper estimated the effect of the additionality of cohesion policy on the allocative choices of domestic expenditure in Italy by using a regional panel framework differentiated by sector.

We have considered regional specificities by adding individual fixed effects and controlling for regional and sectoral specific variables. We have also extensively analyzed the potential endogeneity of cohesion policy and the potential reverse causality in the model specification with several robustness checks. Moreover, we have attempted to disentangle the overall effect of cohesion policy on domestic ordinary spending by estimating the specific impact at the level of the individual Italian regions.

The main contribution of the paper with respect to the existing literature is the evidence of a strong sectoral heterogeneity in the compliance with the additionality principle.

In summary, a substitution effect was discovered in *Education* and *Environment*. An additional effect of cohesion funds to domestic fiscal funds appears in *Other Transport Infrastructure*, *Road Infrastructure* while no effect showed up for *Culture*. Many robustness checks confirmed these results.

Furthermore, we found a considerable level of heterogeneity between regions in measuring the sectoral impact of cohesion spending on domestic one.

The sectoral (and regional) heterogeneity may be related to the different spending nature in each sector or more likely to the practical management of projects when different sources of financing are used.

From the policy point of view, the findings call for greater coordination between national (so called “ordinary”) expenditure policy and cohesion policy in order to avoid that cohesion projects would determine a reduction of domestic spending, especially in some domains that are important for regional growth (i.e., education, environment). In these cases, despite the (ex-ante) additionality rule in force, the ordinary domestic disbursements appear to have been replaced with cohesion ones after obtaining the treatment.

These policy implications are very relevant in the dispute on the efficiency of public expenditure, in particular in evaluating the interactions between domestic fiscal spending and additional resources.

Our results lead to an important rethinking of the additionality principle and suggest its reconsideration into the organization of future European cohesion policy.

More recently, authors have questioned the dismissal of the additionality principle in the recent implementation of this policy before a comprehensive analysis of whether or not it has been complied with for all countries and sectors (Darvas et al., 2019). Heinemann et al., (2024) claimed the need for a reintroduction of the additionality principle both for cohesion policy and for similar fiscal policy measures (Recovery and Resilience Facility).

In our opinion, the supervision of European Commission over EU Funds' additionality should have been maintained and even more strengthened. Instead, the additionality requirement has been eliminated in the current programming period. Recipient countries should clearly demonstrate to the Commission that, in all sectors of intervention, the cohesion treatment has not reduced domestic fiscal disbursements. The reverse situation can only be justified during an (exogenous or endogenous) economic downturn which may cause significant budget problems.

As for national cohesion policy, it could be further strengthened the importance of a coordination between the spending authorities of the national cohesion policy and those of *ordinary* public investments.<sup>29</sup>

If this is not the case, the existence of regional policies may not be conducive to the reduction of territorial imbalances. The literature has raised the question of the cohesion policy effectiveness and extensively investigated where the policy is more effective and which main conditioning factors can mediate the outcome (see, for instance, Ederveen et al., 2006; Dall'Erba and Le Gallo, 2008; Rodríguez-Pose and Garcilazo, 2015; Fratesi and Perucca, 2019; Bachtrögler et al., 2020; Gómez-Gallego et al., 2022; Calegari et al., 2023; Niavis et al., 2024). Failure to comply with additionality could be another potential reason of policy differentiated regional impacts or ineffectiveness. As a related example, Bourdin, (2018), in a study on the contribution of cohesion policy to the growth of Central and Eastern European provinces (NUTS-3), found that the core provinces appeared to take advantage of EU funds more than the peripheral ones and linked this result to a potential greater ability of core areas to enlarge the community support with own resources. Moreover, Di Caro and Fratesi, (2021) studied the regional heterogeneity in the ex-post impacts of the European Regional Development Fund, on a large sample of 250 European regions in a long time span (1990–2015), by finding that in the Italian Mezzogiorno the cohesion payments were ineffective and the authors assumed that this result can be potentially linked to the progressive reduction of the national cofinancing to EU funds and to the progressive reduction of national resources in ordinary domestic policy.<sup>30</sup> Indeed, part of our analysis confirms the occurrence of a substitution effect in the southern Italian regions, but with relevant sectoral and regional differences.

The regional heterogeneity in the evaluation of the additionality principle may reflect the differences in regional priorities and administrative capacities to manage cohesion funds, and the differences in the level of the support by the national (as well as regional and local) governments to the regions which in some cases is mediated by the presence of cohesion funds.

Therefore, additionality may shape the impacts of cohesion funds on regional development by interfering with ordinary government spending. Our article provides a quantitative sectoral assessment of this effect.

This study is limited by its country-specific character.<sup>31</sup> The analysis cannot be extended easily to those countries for which we have data

<sup>29</sup> *Ordinary* interventions are not only managed by the central government but also by decentralized administrations (regions, local authorities, public enterprises).

<sup>30</sup> As explained in Section 5.2, in the context of our analysis, the compelling investigation of the regional heterogeneous effects of the additionality principle in Italy was limited by our small sample size.

<sup>31</sup> The analysis concerning Italy should be tested on other European countries to improve its generality and facilitate a comparison across countries.

limitations on expenditure data distinguished by source of funding, sector and region. Nevertheless, we believe that the main conclusion of the paper can be used by European (and national) policymakers to reconsider the re-introduction of the additionality rule at least for specific sectors.

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## CRedit authorship contribution statement

**Fabio Mazzola:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Debora Gambina:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation.

## Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests. Fabio Mazzola reports financial support was provided by Italian Ministry of University and Research. Debora Gambina reports financial support was provided by Italian Ministry of University and Research. If there are other authors, they 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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## Relationships

There are no additional relationships to disclose.

## Patents and intellectual property

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.pirs.2024.100078](https://doi.org/10.1016/j.pirs.2024.100078).

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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