Beyond Additionality: The Impact of EU Cohesion Policy on Investments by the Member States

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Abstract

We study the crowding-in and crowding-out effects of EU Cohesion Policy, one of the largest public investment programs in the world, on investments in EU Member States. Leveraging a threshold that makes the poorer regions eligible for EU funding, we show that Cohesion funds crowd-out public investments. The retrieved fiscal resources are shifted towards current expenditures, rather than to other regions or periods. Although this crowding-out effect is a clear violation of EU's additionality principle, we show that it is more than outweighed by substantial crowding-in of investments by the private sector. We estimate a multiplier of three euros per invested euro, most of it driven by non-tradable industries like construction. Our complementary difference-in-difference suggests that this effect persist over time. Further ongoing work relying on similar designs estimates GDP and employment multipliers of Cohesion of about one, which works primarily through the crowding-in channel of private investments.

Keywords: EU Cohesion Policy, public and private investments, crowding-out and crowding-in, EU regions, vertical fiscal transfers.
JEL codes: H54, R58, O52.

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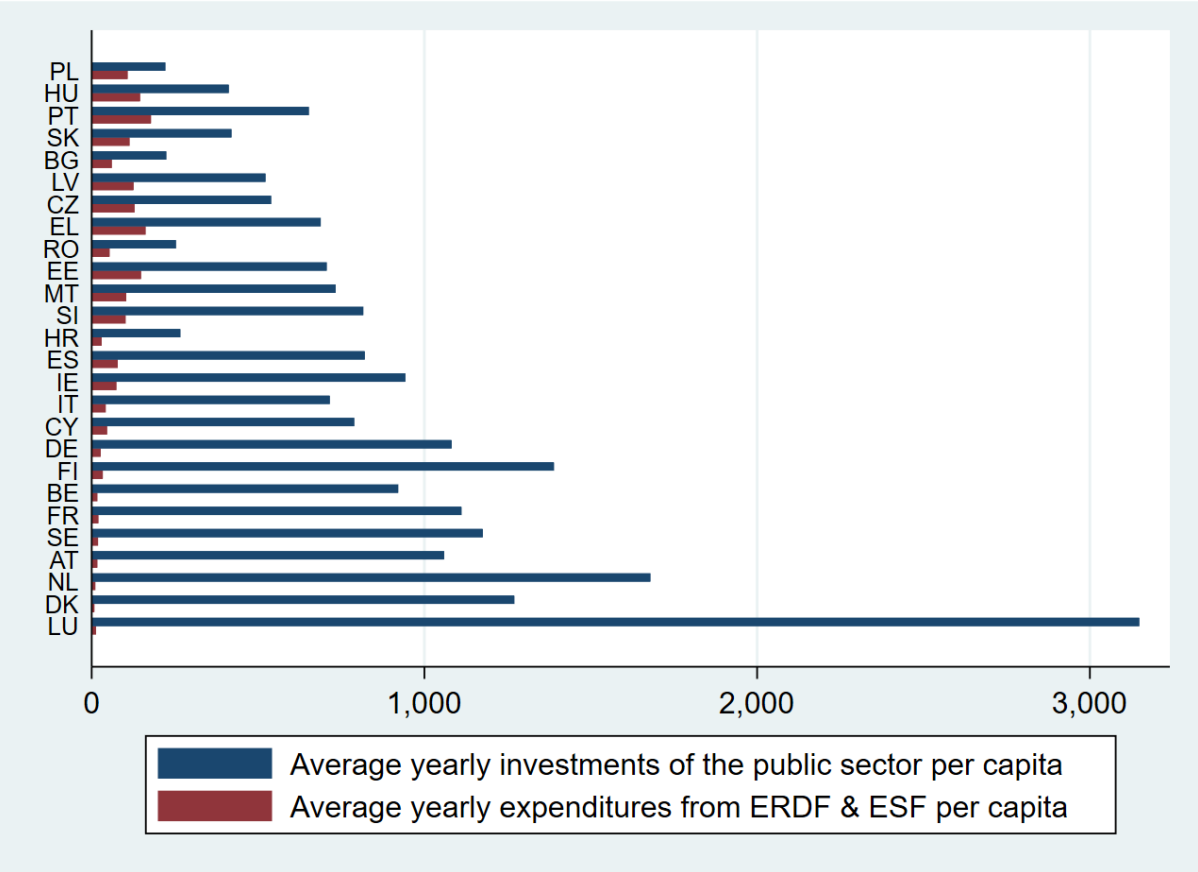
1 Introduction

Cohesion Policy is an important source of public investments in Europe. In an average EU Member State, the European Regional Development Fund (ERDF) and the European Social Fund (ESF) make up about 8% of all public investments. This strong EU involvement reflects the fact that reaching economic, social and territorial cohesion through investments is one of the key objectives of the EU. With this aim to reduce regional disparities, Cohesion Policy is also quite unevenly distributed, with ERDF and ESF financing on average 16% of public investments in Southern European and 26% in Eastern European Member States. Figure 1 of below shows the average yearly per capita public investments financed from cohesion and from national sources. Member States are ordered according to the dependence of their public investments on cohesion funding, with cohesion countries like Poland and Hungary topping the list by up to half of public investments being funded from cohesion resources.

This substantial investment transfers raise an incentive challenge in Member States' budgetary decisions: Member States may potentially use cohesion funds to partially or fully replace national spending on public investments. For some time, the policy answer to this important incentive problem was a formal rule called the additionality principle. The rule, described in more detail in Box 1 of below, aimed to prevent the crowding-out effect of EU funds on national funds by obligating Member States to prove that the EU funds do not simply replace national funds. However, scholars and policy makers are generally sceptical about the plausibility of reliably assessing the degree of this phenomenon, which leads to doubts on whether Member States comply to the principle and how to effectively enforce it (Ederveen et al., 2003; European Commission, 2008; Šlander and Wostner, 2018). As a result, and also with the aim to simplify the already high bureaucratic burden of Cohesion Policy, the current MFF had discontinued this formal rule (Bachtler and McMaster, 2008; European Court of Auditors, 2022).

Fundamentally, we think about the question of whether EU funds crowd-out national funds as an economic rather than as a purely legal question. The interplay between EU funds and Member State investment spending can have either crowding-in or crowding-out effects whereby the

Figure 1: Share of funding from ERDF and ESF in gross fixed capital formation by Member State



Notes: The figure plots the per capita average yearly investments in the public sector captured by gross fixed capital formation of the public sector and the per capita average yearly expenditures in the ERDF and ESF broken down by Member State (for details on data sources and construction see section 'Methodology and Data' below).

EU funds, respectively, complement or substitute Member State investment spending. Moreover, EU funds may have compositional, and not only level effects, by, for example, inducing intertemporal, sectoral, or regional relocations in Member State spending. This means that governments might shift the fiscal resources they receive through the EU funds towards uses at later periods (intertemporal relocation), other purposes in the same region (sectoral relocation), or in other regions altogether (regional relocation). Our paper studies these effects empirically. Such effects of vertical government transfers have been studied extensively in the fiscal federalism literature as reviewed below, but not yet systematically in the context of Cohesion Policy.

An additional and related question we study is whether EU funds crowd-out or crowd-in

private investments, which can happen directly as well through the above-described possible effects of EU funds on national public investments. Public investments may build into productive capital stock, thus increasing the marginal productivity of private capital and crowding-in private investments. On the other hand, public investments may increase capital accumulation above the level chosen by presumably rational private agents, thus leading to crowd-out effects. This question has been studied in the literature on the output impacts of public investments extensively (for early contributions see, Aschauer (1989b,a) and Gramlich (1997)) and is also very important in our context since in the EU the private sector invests 5 to 6 euros for every euro of public investments. Thus, even small interactions between public and private investments will tend to lead to large economic implications.

Understanding these dynamics does not only allow us to speak to Member States' adherence to the additionality principle, but also serves as an important prerequisite in correctly assessing the efficacy of Cohesion Policy. As discussed in more detail below, a large literature studies the output and productivity enhancing impacts of public investments (see Bom and Ligthart (2014) for a meta-analysis and Ramey (2020) for a recent review) such as of infrastructure investments (Fernald, 1999) and that of Cohesion Policies (Becker et al., 2010, 2012, 2013, 2018; Canova and Pappa, 2021). However, if EU funds interact substantially with investment spending by national governments or by private agents, then ignoring the role of such interactions will result in a misinterpretation of the effects of Cohesion Policy on local economies and, consequently, to potentially wrong policy conclusions. Relatedly, possible heterogeneities in the crowd-in or crowd-out parameters may overlap with certain characteristics which the past literature has frequently used to explain the heterogeneity in the impact of Cohesion Policy, such as the rather vague but influential idea of absorption capacity, thus providing a potentially more direct explanation for the mechanisms leading to heterogenous effects of cohesion.

We are able to revisit these important questions in the literature by overcoming two constraints that the past empirical literature has faced. These relate to difficulties in implementing credible identification strategies to study large and significant public investment programs, as well as to constraints of data availability. We follow regression discontinuity type designs

developed in the past literature on the causal effects of Cohesion Policy which provide quasi-random variation in the allocation of cohesion funds (Becker et al., 2010, 2012, 2018; Lang et al., 2022). We then use new data on national investments aggregated at the level of NUTS2 regions and covering several programming periods to study our question. Such region level investment data has been used before (for example, by Canova and Pappa (2021)), and we make progress by separating national public and private investments as well as their more disaggregated sectors.

Our first headline finding is that cohesion funds crowd-out public investments by Member States. This effect is substantial and, depending on the specification, implies a crowd-out of up to 45 cents in national public investments for every euro of cohesion investments. We study the mechanisms that drive this effect, such as whether Member States substitute investments spatially or across types of government spending items. We document a large increase in current government spending, which suggests that fiscal resources get reallocated from investment to current spending. Our second main finding is that cohesion funds have positive effects on private sector investments especially in the non-tradable sectors. This can be either due to their direct complementary nature, or also due to the potential inverse relation of public and private investments of national governments. Either way, the crowd-in effect on private investments is large, and, on average dominates the first effect on national public investments we have documented. Third, we study the temporal dynamics of the effects. Using another empirical approach, one that is complementary to the regression discontinuity design, we study in an event study framework the dynamics of public and private investments in regions that graduate from cohesion eligibility in a period of up to 8 years after losing access to cohesion funds. We show that public investments increase in response to the loss of cohesion funds, thus confirming the crowding-out effect also in this empirical design, but they then rather quickly fall back to the past levels. Private investments also respond in ways consistent to our other evidence, which is by decreasing substantially once cohesion funds are cut, however they remain so even after 8 years implying a permanent drop in investments. Given its magnitude and persistence, this result suggests that part of the large contemporaneous crowding-in effect may be driven by

intertemporal shifts of investments within the private sector, and, more generally, it sheds some doubt on the conjecture that these investments lead to large long-run productivity increases as long as such a boost in productivity should continue attracting investments.

Our analysis contributes to two main strands of literature. First, it relates to the literature on fiscal federalism where it has been long-recognized that, as long as lower-level governments maintain autonomy over their fiscal policies, vertical transfers can be redirected to be used in ways other than what they are designated for. Consequently, one strand of literature, going back to at least Bradford and Oates (1971), studies the conditions and institution under which vertical transfers are effective in increasing the level and quality of local public spending. Another strand researches the conditions that make transfers received increase the level of local public spending more than an increase in local income of equivalent size does, that is the so-called flypaper effect (Courant et al., 1978; Hines and Thaler, 1995). Given that it is the Member States that are responsible for allocating cohesion funds across regions within their countries, a further relevant strand of the fiscal federalism literature is the one that studies the political economy forces leading to the allocation of government resources. Cadot et al. (1999) and Knight (2002) show in theoretical models and empirical applications that political motives and bargaining power greatly determine the joint allocation of resources from different levels of government, which means that only by taking this endogenous allocation process into account, crowd-in or crowd-out estimates can be correctly ascertained. Chalmers (2013) and Bachtler and McMaster (2008) highlight that such a political process of regional lobbying is likewise present in the allocation of Cohesion Policy funds. This implies that conventional regression analysis is biased, if the allocation of EU funds and national public investments is jointly determined by the political importance of a region. We account for this by utilizing a research design that leverages plausible exogenous variation in the amount of EU funds regions receive. Details are described in section 3 below.

Several empirical papers study vertical fiscal relations in the context of interactions between EU funds and national government spending, and doing so either with country level data or with regional data but from from individual Member States. Janský et al. (2016) study Czech

municipalities where they do not find systematic evidence of crowding-out, however note large heterogeneities in their estimates. The paper of Del Bo and Sirtori (2016) on Italian regions also finds heterogeneous effects, but with crowding-out effects dominating on the aggregate driven by cross-sectoral and interregional substitution. In a companion paper, Del Bo (2018) shows that tax rates set by regions in Italy decline as a response to the inflow of EU funds. Both Hagen and Mohl (2009) and Šlander and Wostner (2018) investigate the question with national level data. The former paper finds evidence for crowding-out, while the latter one present evidence of a non-linear relationship of crowding-in effects when cohesion funds are small but crowd-out effects once funds increase and pass beyond a certain level.

Second, we contribute to again a fairly large literature on output effects of public investments. In the short run public investments can increase private demand for both consumption and investment goods, and, in the longer run, these investments can build into a stock of public capital increasing the productivity of the private sector and promoting economic growth. The question of whether government investments crowd-in or crowd-out private investment is always a central parameter of interest in this literature. In the EU context, several papers have studied the general economic effect using both microeconomic and macroeconomic approaches (Becker et al., 2010, 2012, 2013, 2018; Coelho, 2019; Canova and Pappa, 2021). Overall, this literature generally agrees on the aggregate positive effects of Cohesion Policy, but a sub-field of ongoing active research identifies important heterogeneities in its impact across regions. Findings on the more specific question on the productivity impacts of public capital, a field that was particularly active in the 1990s, are reviewed by the meta-analysis of Bom and Ligthart (2014). Some studies find large positive effects (Aschauer, 1989b,a), but others disagree (Garcia-Mila et al., 1996; Evans and Karras, 1994b), and a third group of papers studies further nuances such as different types of investments (Evans and Karras, 1994a), the channels of their impact (Delorme et al., 1999) and the role of spill-overs (Holtz-Eakin, 1994; Owyong and Thangavelu, 2001). A more recent review, in particular focusing on the role of public infrastructure, is provided by Ramey (2020). Most generally, this analysis is related to the literature on fiscal multipliers. The macroeconomic literature is reviewed by Ramey (2011, 2019); Blanchard and Perotti (2002),

and the microeconomic literature on open economy cross sectional multipliers is reviewed by Chodorow-Reich (2019). Similar to our context, most of these papers use shocks from federal expenditure, typically in the US, to identify multipliers in local output and other outcomes (Chodorow-Reich et al., 2012; Nakamura and Steinsson, 2014; Corbi et al., 2019; Serrato and Wingender, 2016).

2 Institutional Background

This section provides additional details around the key concept of additionality, and the related economic ideas of crowding-in and crowding-out.

The design of the EU structural funds has changed over the funding periods, also in regard to the implementation and evaluation of the additionality principle. The key critique throughout the iterations stems from the fact that adherence and verification of the principle was subject to interpretation or relied on bilateral agreements without official independent external evaluation, which rendered comparisons across Member States difficult. This was exacerbated by differences in the information provided across Member States, a lack of monitoring that ensures high quality data, as well as the challenging nature of capturing precisely the relevant and eligible expenditure. The paragraph below details the historic and current developments of the principle:

Additionality principle in EU Cohesion Policy The additionality principle states that any EU-level intervention has to complement existing (national) ones, rather than substituting or replacing them. In the context of EU funding, this principle requires the financial support to be used for projects and programs that would otherwise not have been realised at all, or not to the

extent without EU funding.[1] Adherence to the additionality principle counteracts crowding-out of existing financial resources and ensures resource allocation towards Cohesion Policy goals.

In the Council Regulation for Structural Funds for the 1989 to 1993 Multiannual Financial Framework (MFF), additionality was mentioned as a general guideline for fund disbursement. The regulation stated that funds should have genuine additional economic impact and should lead to an increase of at least equivalent volume in regional or national structural aid from the Member State (EEC No 4253/88).

Building on this general guideline, the following guiding regulations included additionality as a fundamental criterion for access to the funds. The Council Regulations for the three budgetary periods between 2000 and 2020 explicitly required an agreement between the Commission and the Member State about the amount of public structural expenditures, which the Member State was obliged to uphold during the programming period. The level of expenditure provided by the Member State was supposed to be at least as high as in the previous programming period (Council Regulation (EC) No 1260/1999, Article 11, §2). Considerations about the additionality principle were also included in the plans, which Member States had to submit prior to the financing period. In these documents, Member States had to inform about the planned expenditure profile and indicate how the additionality principle was upheld for the expected financial support. This was achieved by submitting overall financing perspectives which detail the national and regional resources allocated to the objectives in the proposed plan. In the 2014-2020 period, the benchmark of structural expenditure could be the regional, instead of at the national level for Member States in which less developed regions cover more than 15% and less than 65% of the population.

Up until the latest MFF budgeting period, the Council Regulation prescribed three points of verification, to ensure adherence to the additionality principle: First, the amount of annual structural expenditure of a Member State eligible for EU cohesion funding had to be examined

[1] European Social Fund Plus, Fact Sheets on the European Union, https://www.europarl.europa.eu/factsheets/en/sheet/53/european-social-fund, accessed 13.06.2023.

ex-ante, which then provided the reference for required national spending in the upcoming funding period. Member States were asked to provide a description of the regional problems towards which the funds would prospectively be allocated to alleviate, and would have to lay out the main national or regional financial resources that would be employed to deal with these issues prior to the upcoming programming period.

Second, adherence to the agreed spending had to be verified within the first three years of the ongoing funding period. In case of developments unanticipated in the ex-ante examination, the Commission and Member State could decide to revise the previous agreement on structural expenditure.

Lastly, an ex-post verification was required. In the 2000-2006 period, this had to be provided before the last year of the programming period (Regulation (EC) No 1260/1999, Article 11, §3c). For the subsequent period from 2007-2013 this evaluation had to be three (for the 2007-2013 period (Regulation (EC) No 1083/2006, Article 15, §4)) or two (for the 2014-2020 period (Regulation (EU) No 1303/2013, Article 95, §5)) years after the end of the programming period.

In addition to these three points, Member States were required to notify the Commission if circumstances arose which might render them unable to adhere to the agreed level of expenditure.

In contrast to the preceding MFF periods, in the current 2021-2027 period, the additionality principle is no longer mentioned (see Regulation (EC) No 2021/1060). The three verification steps previously required are therefore no longer explicitly present in the legal framework governing the Cohesion Policy funding.

The more general economic concept related to additionality is the so-called “crowding-in” effect, which refers to the process wherein EU funds supplement and catalyse national government spending, effectively enhancing the overall financial resources available for development in a given region. In such cases, EU funds incentivize national governments to increase their investments in regions and areas aligned with the EU’s Cohesion Policy objectives. Consequently, part of the positive growth effects can be attributed to the additional spending the EU funds attracted.

Conversely, the phenomenon of "crowding-out" occurs when the inflow of EU funds leads to a reduction in national government spending in the same regions. Member States might assess that EU funds can adequately address regional development needs without domestic financial commitments, which in turn are freed up for alternative projects which might not serve the declared goal of Cohesion Policy. Thus, understanding the potential crowding-out effects is crucial for assessing the true extent of EU Cohesion Policy's impact on regional development.

While crowding-in and crowding-out refer to the total level effects of Cohesion Policy on Member States' own spending, intertemporal, intersectoral and interregional effects describe potential mechanisms that drive potential substitution effects away from domestic governments' spending in certain periods, areas and regions. In essence, if crowding-out takes place, governments might shift the fiscal resources that they perceive to be freed up towards uses at later periods, other purposes in the same region, or in other regions altogether. Likewise, should there be crowding-in, additional spending in the recipient regions can come at the expense of spending in the future, other regions or other sectors in the same region.

3 Methodology and Data

The empirical analysis in this chapter is based on a well-established regression discontinuity design. It leverages the rule according to which funds in the European Regional Development Fund (ERDF) and the European Social Fund (ESF) are allocated: Regions with GDP per capita below the threshold of 75% of the European average are eligible for the vast majority of the payments from the aforementioned funds. This setting allows us to analyse whether there is a causal relationship between the inflows of the EU money from ERDF and ESF funds and per capita public investment spending from the Member States in the same regions. There are two main assumptions that need to hold: The continuity assumption mandates that in absence of the allocation of EU funds according to the rule, regions above and below the 75% threshold would have developed similarly in their public investments, that is there is no secondary confounding treatment taking place that makes regions above and below the threshold have different public

spending paths. The main effort to make this a plausible assumption, is to study only those regions that fall within a certain bandwidth around the threshold, as to not compare regions of vastly differential sizes in terms of GDP per capita. The trade-off in this choice is the following: By choosing smaller bandwidths, the plausibility of the assumption holding improves, however at the cost of statistical power and external validity as the number of regions falling within the bandwidth decreases. We choose a moderate threshold of 40 percentage point following Lang et al. (2022), meaning our baseline estimation includes regions between 35% and 115% of EU average regional GDP per capita share.[2]

The second assumption pertains to regions ability to manipulate their eligibility status, which, if possible, would threaten the quasi-random nature of the allocation rule. The prior literature has shown extensively that the assumption of no manipulation holds, which is also conceptually very plausible. Regions would not only have to be able to manipulate a complex economic aggregate as GDP per capita precisely, they would also have to accurately predict average GDP per capita across the Member States.

We utilize three main data types – all at the level of the NUTS-2 regions across Member States - to employ this RDD. First, we obtained the original regional GDP per capita data from Lang et al. (2022) which informed the decision on a region's eligibility status at the time of the decisions. Second, we collected data published by the European Commission on the disbursement of EU money in the ERDF and ESF funds. Third, we use Gross Fixed Capital Formation (GFCF) broken down by sector according to the Statistical Classification of Economic Activities in the European Community (NACE) to measure investment spending. Below we describe each data type and its application in more detail:

3.1 Historic regional GDP and Cohesion Policy objective 1 eligibility

The empirical design, as described above, relies on comparing eligible and non-eligible regions. As such it is vital to use the information on regional GDP per capita that was at hand at the

[2]In the Appendix we provide robustness checks for all specifications with more narrow bandwidths as well as for the global sample.

time the decision on regions eligibility was actually made. Utilizing more recent and revised data series on regional GDP per capita would lead to a faulty mapping of the eligibility status and bias the results.[3]

In Figure 2 below we map eligible and non-eligible regions over the 5 different funding periods, which make up the time period of our sample. There is some variation in the eligibility status over time. In particular with the gradual eastern expansion of the EU, formerly eligible regions drop their eligibility status.

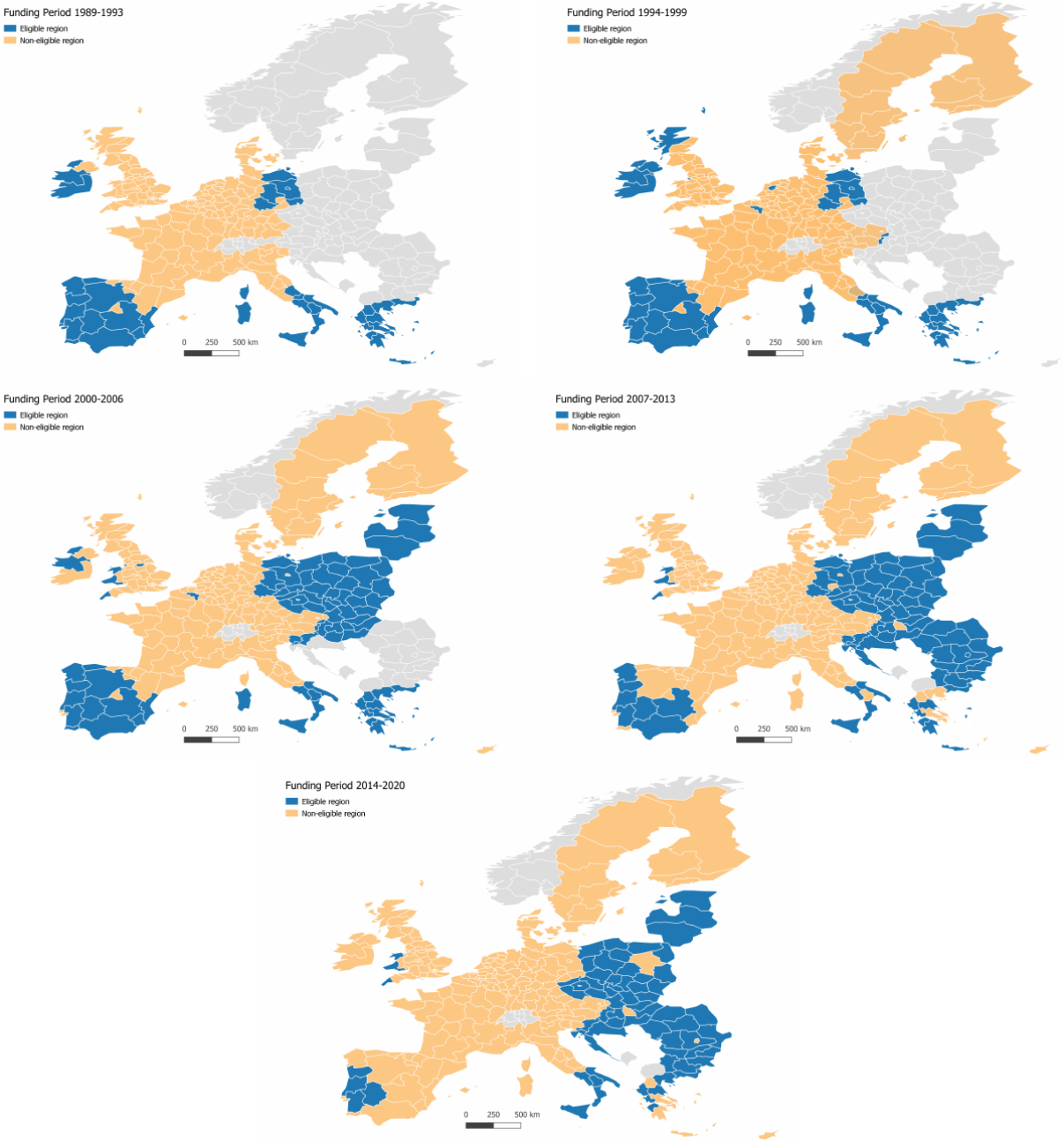
Next up, in Figure 3 we plot for every region and funding period how the formal eligibility matches with the historic GDP per capita data. It is apparent that a regions eligibility status corresponds almost perfectly with its GDP per capita as a share of the EU average, as the allocation rule prescribes. There are 10 regions very close to the threshold that do not comply with the rule, where extraordinary reasons superseded the rule. The specific reason for each of the exceptions is detailed in Table A.2 of Lang et al. (2022), commonly the reason is either remoteness of the region or high unemployment levels while being close to the 75% threshold.

3.2 Cohesion Policy fund disbursement

The second set of data we employ is published by the European Commission and details the yearly funding disbursements in the ERDF, CF, EAFRD/EAGGF and ESF broken down by NUTS-2 regions up until the year 2018. The dataset contains two main variables, namely the annual sum of EU payments and modelled annual expenditure which looks to capture the timing of real expenditures through a model. As the main outcome we use the modelled real expenditures, but utilize the annual sum of EU payments in robustness checks. As our analysis focuses on the ERDF and the ESF due to our empirical strategy, we sum up the modelled expenditures in these funds. Figure 3 below maps the resulting yearly per capita spending over the period from 1989 to 2018. While there are stark differences in the dispersed amounts,

[3]Note that this would even be the case if no observations crossed the threshold comparing the recent to the historic data, as we employ a triangular kernel weighting that assigns larger weights to observations closer to the threshold.

Figure 2: Eligibility status by funding period

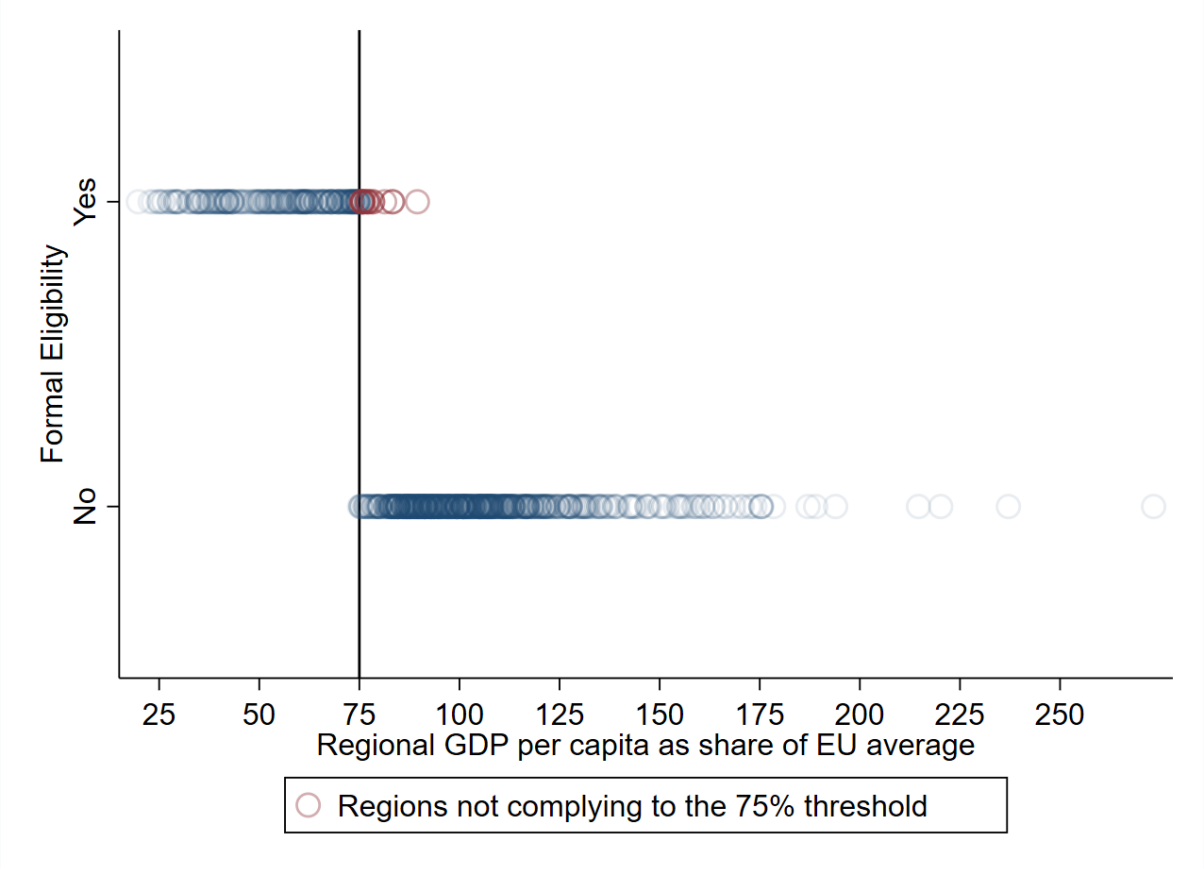


Notes: The maps show the eligible (blue) and non-eligible (yellow) regions over the five funding periods from 1989 to 2020. Grey regions belong to countries that are not EU-Members at the time.

with spending being particularly large in Southern and Eastern Europe, these funds make up a substantial amount of public investment. An average region receives 70€ per capita which on average amounts to roughly 7.5% of public investments.

Using this data on actual fund disbursements instead of the formal eligibility status in our

Figure 3: Compliance with the 75% threshold

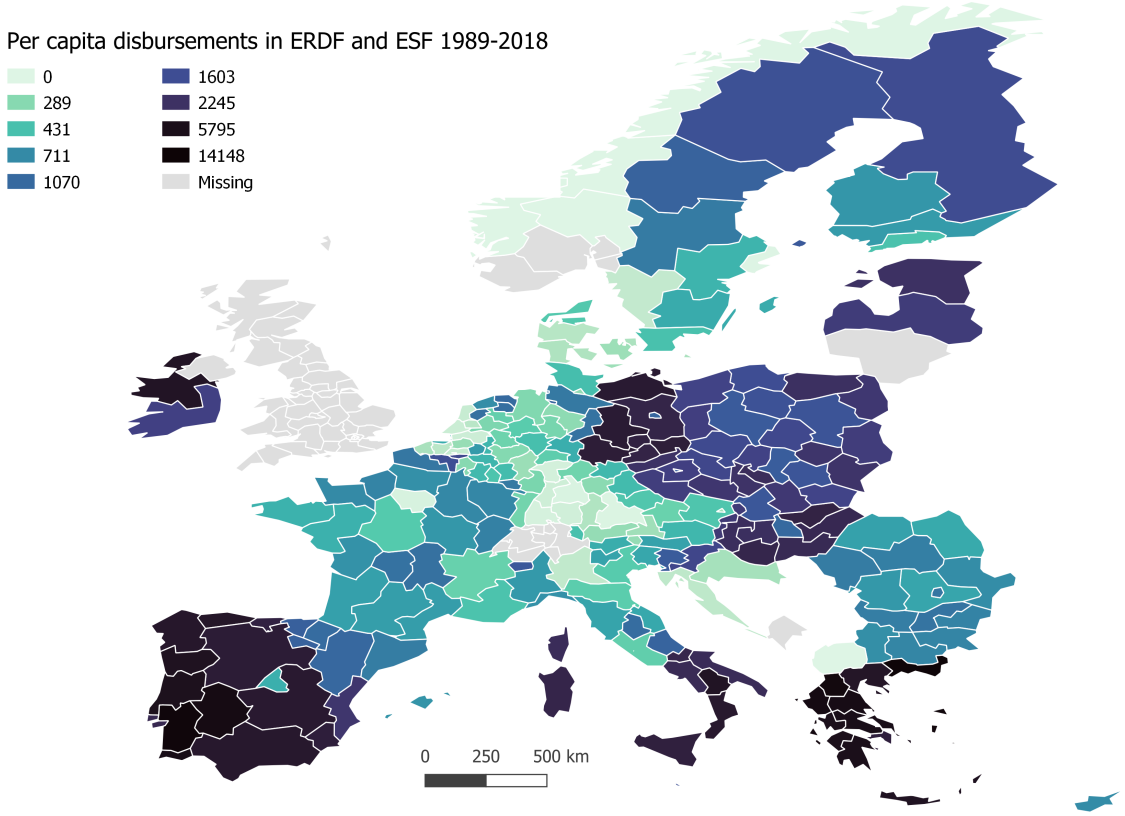


Notes: The figure plots for every region and funding period pair the formal eligibility status against the regional GDP per capita as a share of the EU average at the time of the eligibility decision. We observe almost perfect compliance with the few outliers being marked in red.

empirical strategy has two main advantages. First, as visible in Figure 4, disbursements vary even across eligible regions drastically, and as such utilizing the actually disbursed amounts in the regions will improve the precision of the estimated effects greatly. Second, it allows us to express effects in a euro for euro scale: How much does public investment per capita change with every per capita euro inflow of EU money.

Figure 4 also reveals that not only eligible regions, but also non-eligible regions receive funding from the ERDF and ESF, albeit significantly less. This is consistent with the allocation, which requires the majority, but not all of the funds going to the regions eligible for objective 1 funding. Given that our empirical strategy relies on comparing regions above and below the objective 1 eligibility threshold, we need to verify that these regions indeed receive

Figure 4: Per capita regional dispersion of EU cohesion funds

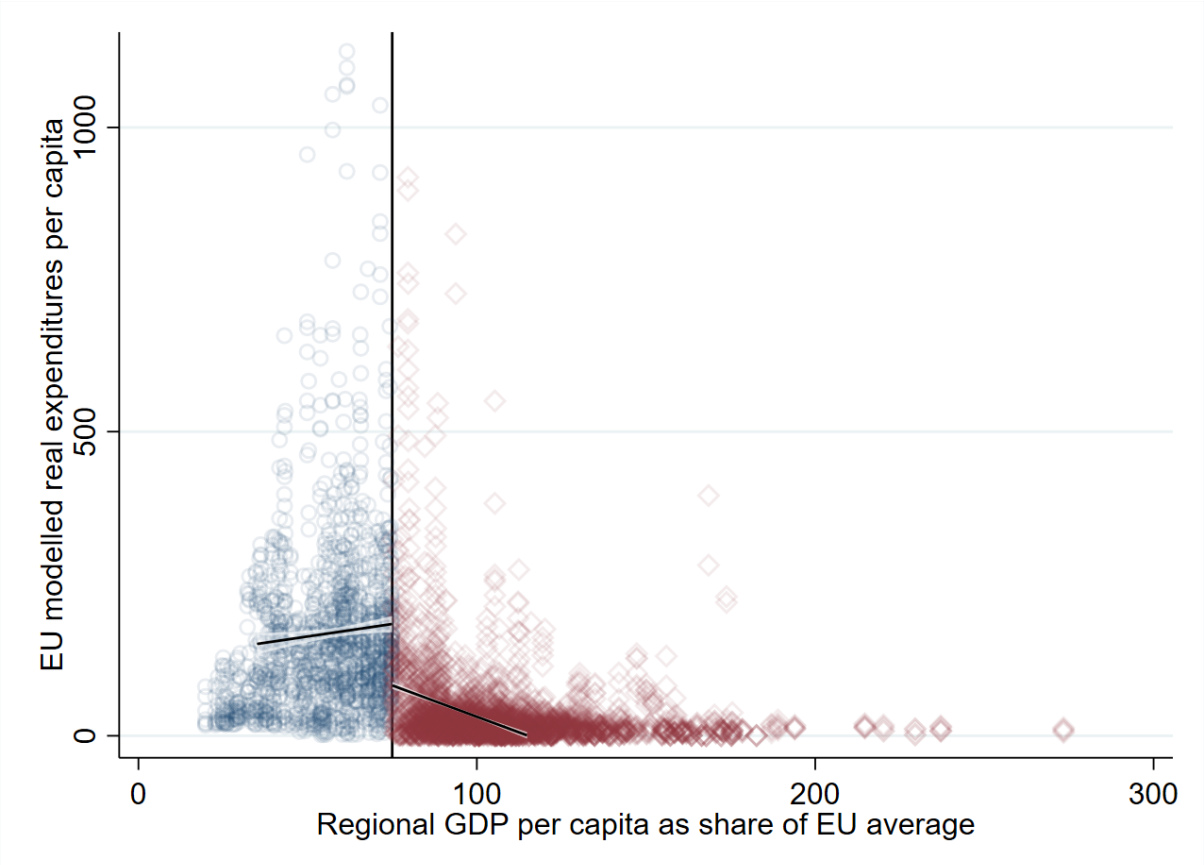


Note: The map plots the per capita amount of funds dispersed from the ERDF and ESF fund received by NUTS-2 regions between 1989 and 2018, expressed in yearly current EUR prices. Darker colours indicate larger funding amounts received.

significantly differential amounts of funds. In Figure 5 we therefore plot the yearly per capita real expenditures of ERDF and ESF in relation to the 75% allocation threshold. The figure also contains local linear fits of the data to the left and to the right of the threshold within our baseline bandwidth, which reveal the expected discrete jump in per capita EU expenditures at the threshold.

Combining the data on the historic regional GDP per capita as a share of the EU average, the formal eligibility status of regions, and the per capita amounts of yearly EU expenditures from ERDF and ESF allows us to run three distinct versions of the RDD. Due to the advantages mentioned above, we utilize EU expenditure amounts in our baseline specification. To this end, we run a so called 'fuzzy' RDD, where we use the modelled EU expenditure amounts in per

Figure 5: EU per capita real expenditures in relation to the allocation threshold



Notes: The figure plots the modelled yearly EU per capita real expenditures in the ERDF and ESF for all NUTS-2 regions in the sample in relation to their region GDP per capita as a share of the EU average. The black vertical line marks the 75% threshold. The regression lines to the left and right of the threshold show the local linear fits with 95% confidence intervals within the baseline bandwidth.

capita terms as the treatment variable. To verify that our results are robust to alternative specifications and data, we adopt the fuzzy RDD to use the formal eligibility status as an alternative treatment.[4] Furthermore, we estimate a sharp RDD where we exclude the non-complying re-

[4]The 'fuzzyness' of this RDD refers to the fact that regions above the threshold also receive partial funding (or in the case where we use formal eligibility as the instrument, that some regions above the threshold are eligible due to exceptions as shown in Figure 2), such that there is no sharp cut in the treatment across the allocation threshold. The design accounts for this by running a first-stage where the treatment is instrumented by a dummy variable that identifies observations above the eligibility threshold. In Figure A.1 of the Appendix we show for bandwidths larger than 20 that this first-stage regression yields large, precise estimates, speaking for the validity of the instrument.

gions above the 75% threshold and estimate the local average treatment effect of crossing that threshold directly.

3.3 Member States' public investment and current spending

Finally, we use data on yearly public investment spending at the level of NUTS-2 regions. To this end, we make use of the Annual Regional Database of the European Commission (ARDECO), which is a database maintained by the Joint Research Centre in collaboration with the Directorate General for Regional and Urban Policy. It contains information at the required level on population, employment, labour cost, domestic product and capital formation. We extract Gross Fixed Capital Formation (GFCF) which is broken down by NACE sectors and expressed at constant 2015 Euro values. The NACE codes allow us to identify the agricultural sector (NACE code A), the industrial sector (NACE code B-E), the construction sector (NACE code F), the service sector (NACE code G-J), the financial sector (NACE code K-N), and most importantly the public sector (NACE code O-U).[5] Gross fixed capital formation is defined by the OECD as "the acquisition of produced assets (including purchases of second-hand assets), including the production of such assets by producers for their own use, minus disposals".[6] GFCF does not include purchases of land or natural resources, as these do not qualify as produced assets under this definition. Additionally, we obtain population numbers on the level of regions from the same database, in order to transform our variables into per capita terms.

The average public investment per capita across all years and regions in our sample is 959 euros, which makes up on average around 17% of all investments in a region. Figure 6 below maps public and private sector per capita investments as captured by GFCF averaged over the years 2010 to 2015.

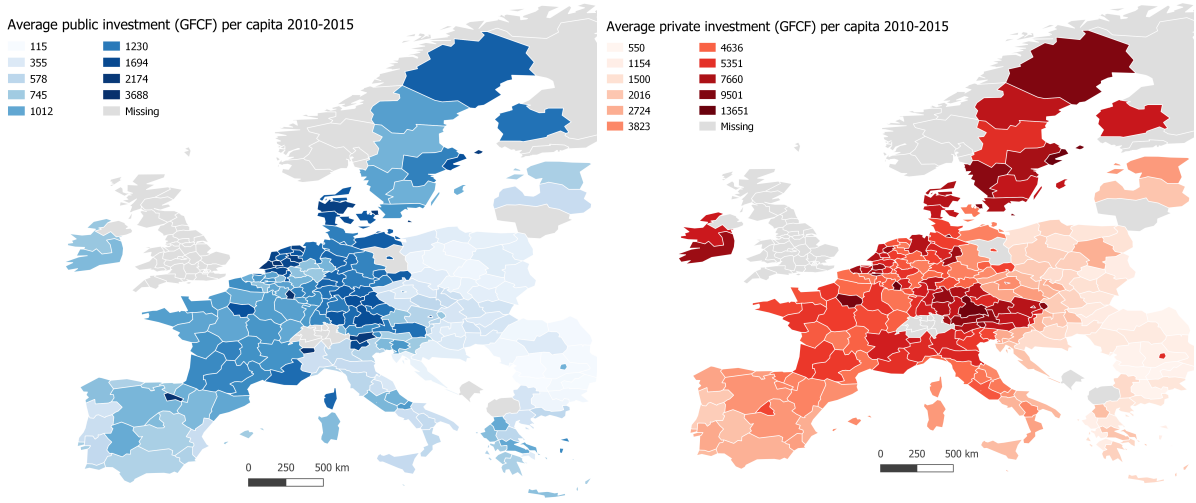
The maps reveal stark differences in average per capita investment levels across and within Member States. The general patterns are lower investments in Eastern and Southern Europe,

[5]When we use the private sector as an aggregate we group together NACE codes A-N.

[6]From https://data.oecd.org/gdp/investment-gfcf.htm, accessed: 20.11.2023.

Figure 6: Average regional per capita investments in private and public sector 2010-2015

(a) Public investments **(b)** Private investments



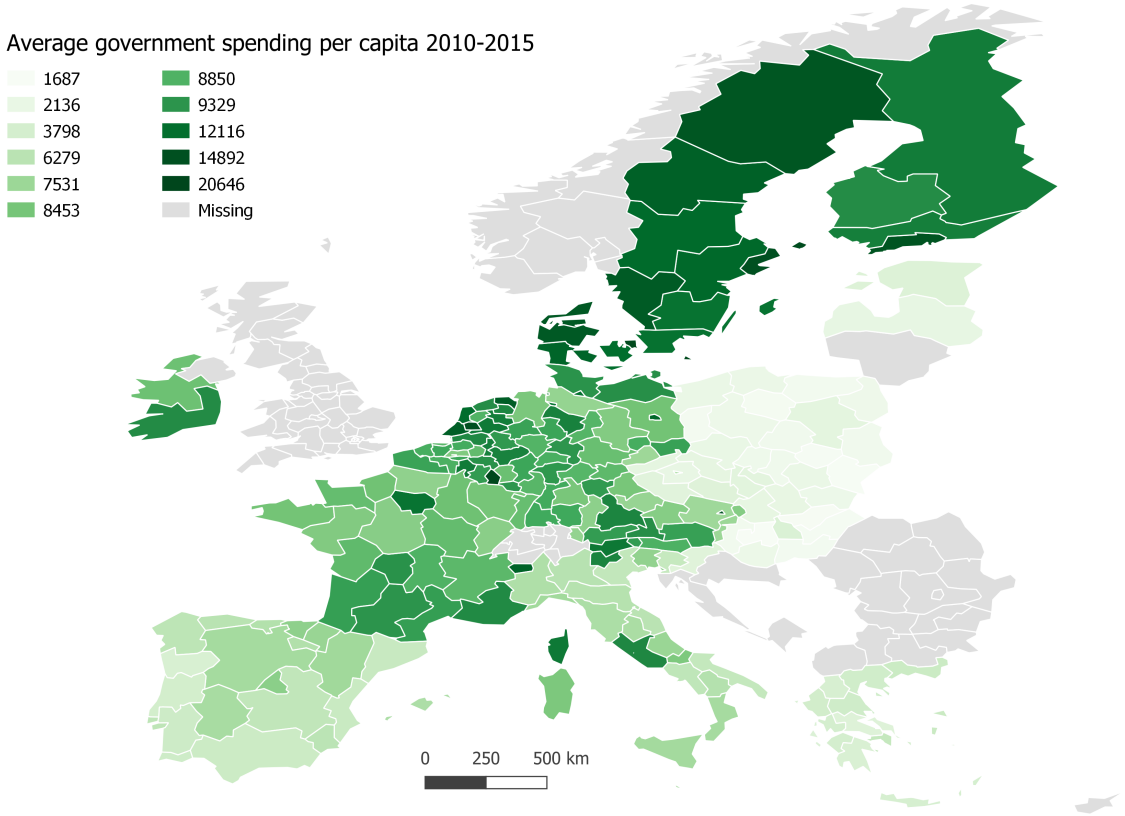
Notes: The figure plots the average values of regional gross fixed capital formation over the years 2010 to 2015, in the left panel for the public sector (NACE codes O-U) and in the right panel for the private sector (NACE codes A-N). Darker values represent larger amounts, grey coloration indicates missing values.

and higher investments per capita in regions hosting the capital cities. In our empirical analyses we utilize the year-on-year change rate in per capita investments.

To be able to capture the full picture of government spending activities, we complement the data described above with a measure that approximates current government spending at the NUTS-2 region level following Gabriel et al. (2022). The measure is comprised of the sum of gross value added (GVA), which itself is made up from compensation to employees including social contributions, consumption of fixed capital, and taxes minus subsidies on production, and intermediate consumption of the public sector.[7] Gabriel et al. (2022) argue that the measure is a valid proxy for current government spending, because changes in the public sector GVA can mainly be attributed to government activities. Accordingly, they show that this proxy and government spending are found to be almost perfectly correlated. Following the

[7]The six sub-sectors that make up the public sector are: "Public administration and defense", "Education", "Human health and social work", "Arts, entertainment and recreation", "Other service activities," and "Activities of household and extra-territorial organizations and bodies".

Figure 7: Average regional per capita current government spending 2010-2015



Notes: The figure plots the average values of regional per capita current government spending over the years 2010 to 2015. Darker values represent larger amounts, grey coloration indicates missing values.

authors, we construct the measure using data on GVA from ARDECO and data on intermediate consumption constructed from input-output data acquired from the PBL EUREGIO database. Figure 7 below visualizes the average regional per capita current spending by EU Member State governments from 2010-2015.

4 Results

We start by presenting our baseline findings. Columns 2 and 3 of Table 1 collect the results from the second-stage of the fuzzy RDD, where the dependent variable is the year-on-year change in per capita public investments.

We find a negative and statistically precisely estimated effect of EU cohesion funds on public

Table 1: Per capita EU funds and year-on-year changes in investments

VARIABLES	(1) All sectors	(2) Public sector	(3) Public sector with pass-through	(4) Current government spending	(5) Private sector
Cohesion funds per capita	1.5848***	-0.1656***	-0.4482***	1.5636***	1.7503***
	(0.0607)	(0.0146)	(0.0178)	(0.1207)	(0.0688)
Robust 95% CI	[1.466 ; 1.704]	[-0.194 ; -0.137]	[-0.483 ; -0.413]	[1.327 ; 1.8]	[1.616 ; 1.885]
Kernel Type	Triangular	Triangular	Triangular	Triangular	Triangular
BW above/below	40/40	40/40	40/40	40/40	40/40
N above/below	2667/1363	2667/1363	2667/1363	2641/1234	2667/1363

Notes: The table presents the second-stage results from the baseline fuzzy RDD specification, where the outcomes are year-on-year changes in per capita investments in (1) all sectors, (2) the public sector, (3) the public sector subtracting ERDF and ESF funding, and (5) the private sectors. The outcome in (4) are year-on-year changes in per capita current government spending. Observations are at the level of NUTS-2 regions and years, and treatment is given by yearly regional per capita expenditures from the ERDF and ESF. Estimations include country and year fixed effects. The presented estimates are linear bias-corrected with robust nonparametric standard errors clustered at NUTS-2 level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

investments by the Member States. The magnitude of the effect depends on assumptions of how much of the cohesion funds are translated into public investments, since the data on national public investments already includes investments financed from cohesion resources. For this reason, we identify two bounds. At the lower bound, we assume that all of cohesion funds are passed on to become public investments and, thus, we subtract ERDF and ESF expenditures from public investments. The estimate of column (3) suggests a crowd-out parameter of 45 cents per euro of Cohesion Policy funding. The upper bound estimate, which assumes that the pass-through is null, is shown in column (2) and it suggests an estimated crowd-out of 17 cents per euro of cohesion funds. We find the full pass-through assumption to be more realistic, and study the mechanisms behind this effect in more detail the next sub-sections. However, it is useful to show that, even under the very conservative assumption that cohesion funds somehow do not translate to public investments at all, our estimate is still significantly smaller than zero and is suggestive of a crowd-out effect.

4.1 Substitution and Relocation Effects

We discuss two potential mechanisms behind the large crowding-out effect that we have measured for public sector investments: Substitution across types of government spending and spatial relocation of government investments.

The first plausible explanation is that the investment spending financed by EU funds frees up national money to be spent for more consumptive purposes. We investigate this explanation empirically in column (4) of Table 1. The column displays the second-stage results from the baseline regression utilizing the year-on-year change in current government spending as captured by the proxy we introduced in the data section. The positive coefficient of 1.56 suggests, that each additional euro of EU funds comes with a more than 1 euro increase in consumptive government spending. The size of this effect is larger than the crowding-out effect in public sector investments discussed above. It is plausible that this very large increase in current government expenses is at least partially financed by freed-up monetary resources from investment projects, which are covered by the EU funds.

A second potential mechanism driving our finding is a regional substitution effect. That is investments from the regions receiving EU funds get shifted to regions which do not. If this type of substitution takes place and those receiving regions are within the bandwidth of our analysis, the crowding-out effect gets exaggerated, because mechanically the control regions increase their spending by the amount the treatment regions loose out. Unfortunately, it is difficult to directly test how large this effect is. Doing so would require us to accurately predict how large spending was in the control regions in the absence of the policy, or be able to account for every euro earned (taxes and debt) and spent by the government on the region level. However, it is possible to calculate the upper bound of the relocation effect. Assuming the most extreme case, in which every euro that is crowded-out in the treatment regions gets instead spent in the control regions, the average treatment effect would have to be adjusted by one quarter, taking into account the relative sizes of the treatment group and the twice as large control group.[8]

[8]One caveat is, that the relative distance of the regions loosing and receiving the spending from crowd-in and -out to the 75% threshold needs to be considered, because of the weights imposed by the triangular kernel. As

Thus, even the most conservative crowd-out effect of 17 cents per additional euro of cohesion would become 12 cents per euro, and so well different from a no crowd-out scenario of null effects.

4.2 Effects on the Private Sector

Next, we study the effects on private sector investments. As before, we use the fuzzy RDD approach and study year-on-year change in per capita investments. Column (5) of Table 1 suggests that EU funds substantially crowd-in private investments. Every euro spent by Cohesion Policy leads to additional 1.75 euros of investments by private sector agents. Table 3 below breaks down this effect into more granular sectors. Overall, we see positive effects across all sectors, other than the industrial sector where there is a crowding-out effect. The aggregate effect is driven by modest crowd-in in the construction sector, and large crowding-in in services and the financial sector. We do not exactly know the reasons behind these differential effects but, in the short-term, they are a combination of direct demand effects for both inputs and outputs of these industries as well as potential crowd-out effects due to the reallocation of labour and capital from certain sectors to catering the investments funded by cohesion.

Overall, however, given the much larger underlying size of private than public investments, these positive private sector effects dominate the crowd-out effect on public investments. As shown in column (1) of Table 1, every euro of Cohesion Policy spending raises total public and private investments by about one and half euros.

4.3 Robustness Tests

Our main findings of crowding-out in the public sector and crowding-in in the private sector are robust across a number of specifications. We show the robustness of our results to: i) utilizing the alternative outcome of the annual sum of EU payments (see Appendix Table A.1), ii) the

such the example presents a minor simplification, however there is no reason to believe that a relocation effect would systematically target regions in the control group that are farther away from the eligibility threshold.

Table 2: Per capita EU funds and year-on-year changes in private investments by sector

VARIABLES	(1) Construction sector	(2) Industrial sector	(3) Service sector	(4) Financial sector	(5) Agricultural sector
Cohesion funds per capita	0.1914***	-0.5412***	1.0000***	1.0125***	0.0877***
	(0.0103)	(0.0222)	(0.0309)	(0.0385)	(0.0097)
Share in private investments	1.75	19.90	15.74	55.45	7.16
Robust 95% CI	[0.171 ; 0.212]	[-0.585 ; -0.498]	[0.939 ; 1.061]	[0.937 ; 1.088]	[0.069 ; 0.107]
Kernel Type	Triangular	Triangular	Triangular	Triangular	Triangular
BW above/below	40/40	40/40	40/40	40/40	40/40
N above/below	2667/1363	2667/1363	2667/1363	2667/1363	2667/1363

Notes: The table presents the second-stage results from the baseline fuzzy RDD specification, where the outcomes are year-on-year changes in per capita investments in (1) the construction sector (NACE F), (2) the industrial sector (NACE B-E), (3) the services sector (NACE G-J), (4) the financial sector (NACE K-N), and (5) the agricultural sector (NACE A). Observations are at the level of NUTS-2 regions and years, and treatment is given by yearly regional per capita expenditures from the ERDF and ESF. Estimations include country and year fixed effects. The presented estimates are linear bias-corrected with robust nonparametric standard errors clustered at NUTS-2 level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

alternative treatment of formal eligibility for funding (see Appendix Table A.2), iii) the sharp RDD specification (see Appendix Table A.3), iv) other choices of the bandwidth (see Appendix Figure A.2), and v) employing region instead of country fixed effects (see Appendix Table A.4).

4.4 Longer-Run Effects

An important question regarding the crowding-out and crowding-in effects that we have documented for the public and private sectors, respectively, pertains to the persistence of these effects. To study this question, we utilize a secondary research design based on the major eastward expansion of the EU in May 2004, which saw Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia joining the Union. In particular, we leverage the fact that the EU average regional GDP was lowered by the inclusion of these countries, which led to a number of regions losing their eligibility status as cohesion regions. While these phasing-out regions received some transitory support, they missed out on receiving the majority of funding by losing their eligibility for objective 1 funding starting in the programming period of 2007-2013.

We first run Difference-in-Difference (DiD) regressions and then show the dynamics of the effects in an event study framework. The control group comprises of regions, which remained

Table 3: Effects of funding loss after the EU east expansion

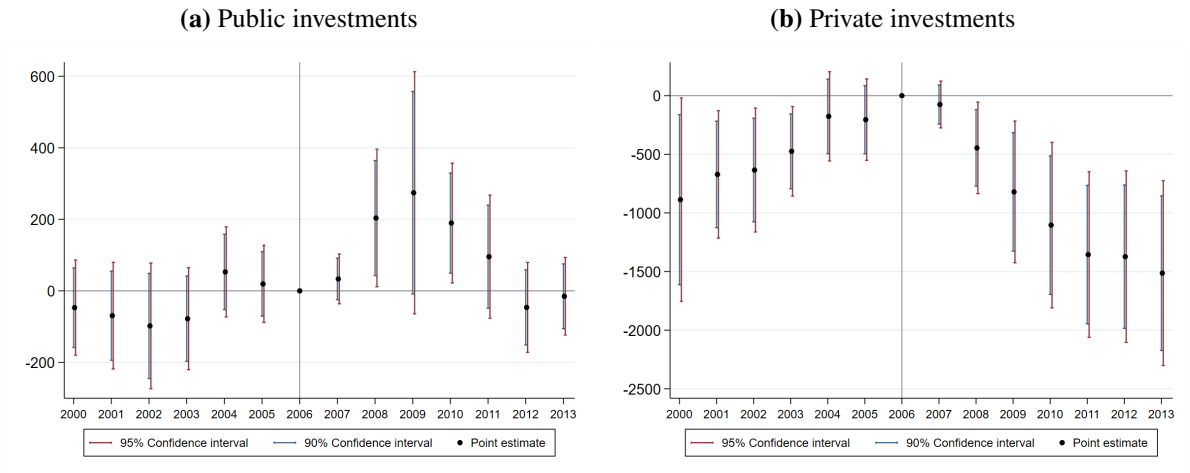
VARIABLES	(1) Public sector with pass-through	(2) Current government spending	(3) Private sector
Panel A: All dropout regions			
Dropout region # post	125.7989**	-97.9113	-578.6429***
	(58.6527)	(119.3703)	(218.1364)
Observations	1,024	1,024	1,024
R-squared	0.7417	0.9847	0.8140
Panel B: Only phasing-out			
Phase-out region # post	183.1661**	-132.9691	-120.4366
	(79.1677)	(175.2649)	(178.9983)
Observations	902	902	902
R-squared	0.7478	0.9854	0.8229

Notes: The table presents estimates from a difference-in-difference specification. We compare in the upper Panel A all regions dropping out of the formal eligibility status, and in the lower Panel B only the phasing-out regions who lost their funding status due to the EU east expansion, to the control group consisting of all those regions remaining eligible between the 2000-2006 and 2007-2013 MFF. The sample is restricted to only include regions eligible in the 2000-2006 period and to the years 2000 to 2013. The regression includes NUTS-2 region and year fixed effects. 90% and 95% confidence intervals are displayed and standard errors are clustered at the NUTS-2 level.

eligible for cohesion funds between the 2000-2006 and the 2007-2013 programming periods, and the treatment group comprises either of all regions losing eligibility during the 2007-2013 period or only the sub-sample of the phasing-out regions. The upside of using the former treatment group is that we have a larger sample size which gives the estimates higher precision. The latter treatment group, on the other hand, relies on variation coming from the expansion of the EU and is, thereby, less likely to suffer from endogeneity concerns, such as a potential bias stemming from the fact that regions anticipate the timing of losing the eligibility status.

Table 3 collects the results. In column (1) we study public investments assuming full pass-through, as discussed in section 4.1 above. In both treatment groups, shown in the upper and lower panels of Table 3, we find a positive effect implying that regions respond to losing their eligibility status by increase their public investments. This result is in line with the crowding-out effects we documented before: National public investments increase when cohesion funds

Figure 8: Event study on public and private investments around the time regions lose cohesion eligibility



Notes: The figure presents Event Studies on the annual change of per capita investments in the public (left sub-figure) and private (right sub-figure) sectors. The treatment group consists of all regions dropping their eligibility status going from the 2000-2006 MFF to the 2007-2013 MFF. The control group consists of regions that remain eligible during both budgeting periods. The regression includes NUTS-2 region and year fixed effects. 90% and 95% confidence intervals are displayed and standard errors are clustered at the NUTS-2 level.

decrease, and national public investments decrease when cohesion funds increase. In column (2) we move to current government spending, where effects are negative, but are very imprecisely estimated. This loss of statistical power may be driven by the reduced sample size due to restricting the period to only two programming periods and only the few regions losing their cohesion status. As such, we cannot draw a clear conclusion for current government spending. We note, however, that the negative effect size is consistent with the effect of substitution from investments to current spending that we identified before. Finally, in column (3) we investigate the effects for private investments. For the larger sample of all dropout regions we find sizeable reductions in per capita investments when regions lose their eligibility, which complements the large crowding-in effect we documented for the inflow of EU funds. The reduction is suggestive of an intertemporal substitution, meaning that the private sector invests when complementarities from Cohesion Policy investments can be utilized, but thereby foregoing investments they would have made at later points.

To study the dynamics of these average effect, we estimate event studies for changes in public

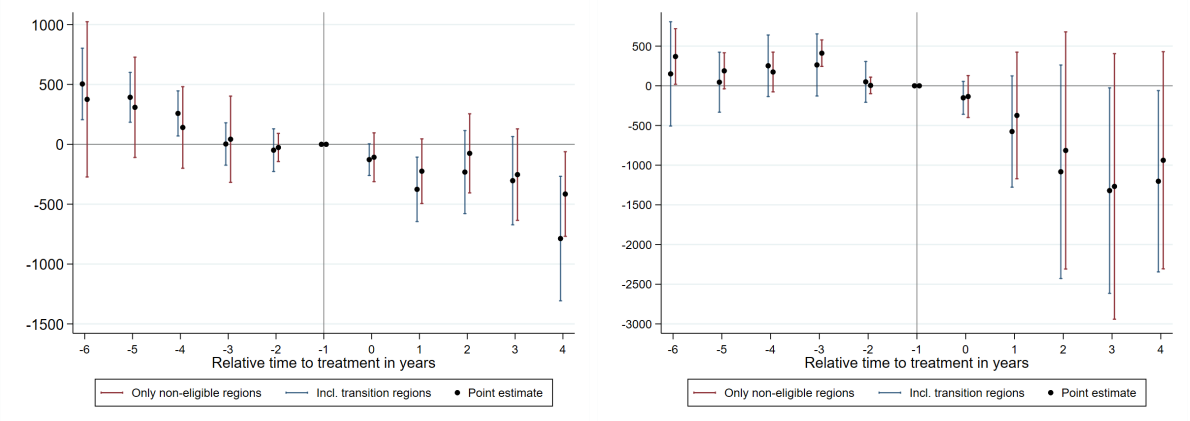
and private investments around years of losing eligibility. In Figures 8 and 9 we calculate the yearly changes for the treatment group of all drop-out regions compared to our control group and the base year of 2006. For both public and private investments we see no significant change in the first year following the loss in the eligibility status, which is plausible given that substantial amounts of funding are typically still being spent in the year or two after the end of a programming period. After this initial period, we observe increases in public investments in the left panel of Figure 8, and decreases in private investments in the right panel of Figure 8 reverting the trend of increasing investments. These effects are consistent with the respective crowd-out and crowd-in effects on public and private investments we have identified in the baseline approach. In the longer run, we see that growth in public investments is temporary going back to the levels observed during eligibility after about 6 years. The decline in private sector investments, on the other hand, is permanent and stabilizing at a much lower level after about 5 years compared to the levels of investments observed during periods of eligibility.

This last piece of evidence is also inconsistent with the hypothesis that the crowding-in of private investments is largely driven by intertemporal substitution effects. That is because this hypothesis would imply the existence of short-run effects rather than effects that are persistent over time. A similar hypothesis but related to cross-regional substitution effects is discussed in the next sub-section.

4.5 Regional Spill-overs

An important remaining question is whether the large private sector crowd-in result is driven by cross-regional substitution effects, that is cohesion-simulated investments coming at the expense of fewer investments in other regions rather than being genuinely new investments. To test this hypothesis, we use the difference-in-difference methodology of Section 4.5 and study the dynamics of investments in non-eligible regions in places where some regions lose their eligibility status going from one MFF to the next. If the hypothesis of cross-regional substitution effects was true, we would expect that the non-eligible regions see a recovery in the level of their private investments after the cohesion regions lose their funding. We implement

Figure 9: Private investments in non-eligible regions around the time regions lose eligibility



Notes: The figure presents Event Studies on the annual change of per capita investments in the private sectors. In the left subfigure, the treatment group consists of all non-eligible regions in countries where at least one region loses its eligibility status going from one MFF to the next. In the right subfigure, the treatment group are non-eligible regions that are within the same Nuts-1 region of at least one Nuts-2 region dropping its eligibility status going from one MFF to the next. The control group consists of non-eligible regions in countries and Nuts-1 regions respectively where no region drops its eligibility status. The estimation accounts for staggered treatment timing (de Chaisemartin and D'Haultfoeuille (2024)). 90% and 95% confidence intervals are displayed and standard errors are clustered at the NUTS-2 level.

this test by looking at non-eligible NUTS2 regions in countries where at least one NUTS2 region graduates from cohesion, and, more granularly, non-eligible NUTS2 regions in NUTS1 regions where another NUTS2 graduates from cohesion. Left and right sub-figures of Figure 9 shows the results for these two tests. They suggest that, if anything, there is a negative not a positive effect in non-eligible regions suggesting that the spill-overs might even be positive.

5 Conclusions

Our analysis provides strong evidence for the view that, in the context of Cohesion Policy, the additionality principle has been being violated systematically. That is, we provide quasi-experimental evidence from across the EU regions and covering several programming periods showing that cohesion funds partly replace public investments by the Member States. The magnitude of this effect is large, in the order of up to about 45 cents per one euro of cohesion

funding, and it is consistent with anecdotal evidence and existing evidence from individual Member States. Our analysis of the mechanisms behind this result suggests that Member States likely use the freed-up money from decreased investment spending towards current government spending.

Although this large crowd-out effect that we document speaks for the potential existence of a policy space where Cohesion Policy can be improved so as to avoid crowding-out national investments, it is not sufficient to suggest that the additionality principle should be restored. First, as reflected in the decision to drop the additionality principle, such a rule is likely not plausible to implement so as to enforce the case of no crowd-out; a phenomenon which we claim to be a general economic one rather than a narrower legal one. Second, the relation between national public investments and private investments is not clear; if there is a large degree of substitution as claimed by parts of the economic literature, then the additionality principle may even become counter-productive, such that additionality cannot be a goal in itself.

Furthermore, and more importantly, our analysis suggests that the crowding-out of national public investments is not the elephant in the room. We show that Cohesion Policy crowds-in investments from the private sector and that this is the more important margin to consider. Given the large underlying share of private capital compared to public capital, the positive effect on private investments more than cancels the negative effect on public investments, overall leading to a large crowding-in of total investments. This result is not surprising in the sense that the European Commission often incentivizes cooperative projects with the private sector, such as with cohesion instruments that co-finance public-private partnerships. Such participation of the private sector is further explicitly facilitated by the financing instruments of the European Investment Bank which are substantial in magnitude.

Our analysis on the longer run effects of cohesion shows that after regions graduate from being cohesion eligibility, private investments in these regions decline and do so in a sizeable and permanent fashion. This permanent decrease is inconsistent with the hypothesis that the contemporaneous crowd-in effect is driven by intertemporal shifts of investments, since that

hypothesis implies that investments would restore to their original level after some time. Our evidence is also inconsistent with the hypothesis that private investments relocate from non-cohesion to cohesion regions in response to Cohesion Policy, if anything the evidence speaks in favour of positive regional spill-overs. The study of other mechanisms that lead to these effects are left to future work, such as related to regional absorptive capacities, as well as the implications of this evidence on what we know about the heterogenous growth effects of Cohesion Policy.

Overall, our results suggest that the debate over designing a growth-oriented Cohesion Policy should go beyond the question of additionality and take into account the private sector. In particular, such policy should make sure that investments under cohesion continue to create public capital that is complementary to private capital, and do so in a long-term vision. This may depend on the area of investments and their timing, among other factors. On the area, evidence suggests that current Cohesion Policy may be crowding-out tradable sectors like manufacturing, but crowding-in investments in industries like services, construction and even finance. More detailed analysis, possibly distinguishing between the types of cohesion investments, could try to identify the projects that lead to productivity-enhancing effects in the longer term. On timing, these crowding-in parameters may strongly depend on the business cycle given financial frictions in the private sector, however cohesion is not particularly designed to follow business cycles. Such a re-design would target resources to times when the economy needs to be stimulated, and it would have to take into account delays and absorption problems to make sure Cohesion Policy is not unsynchronized from the cycle.

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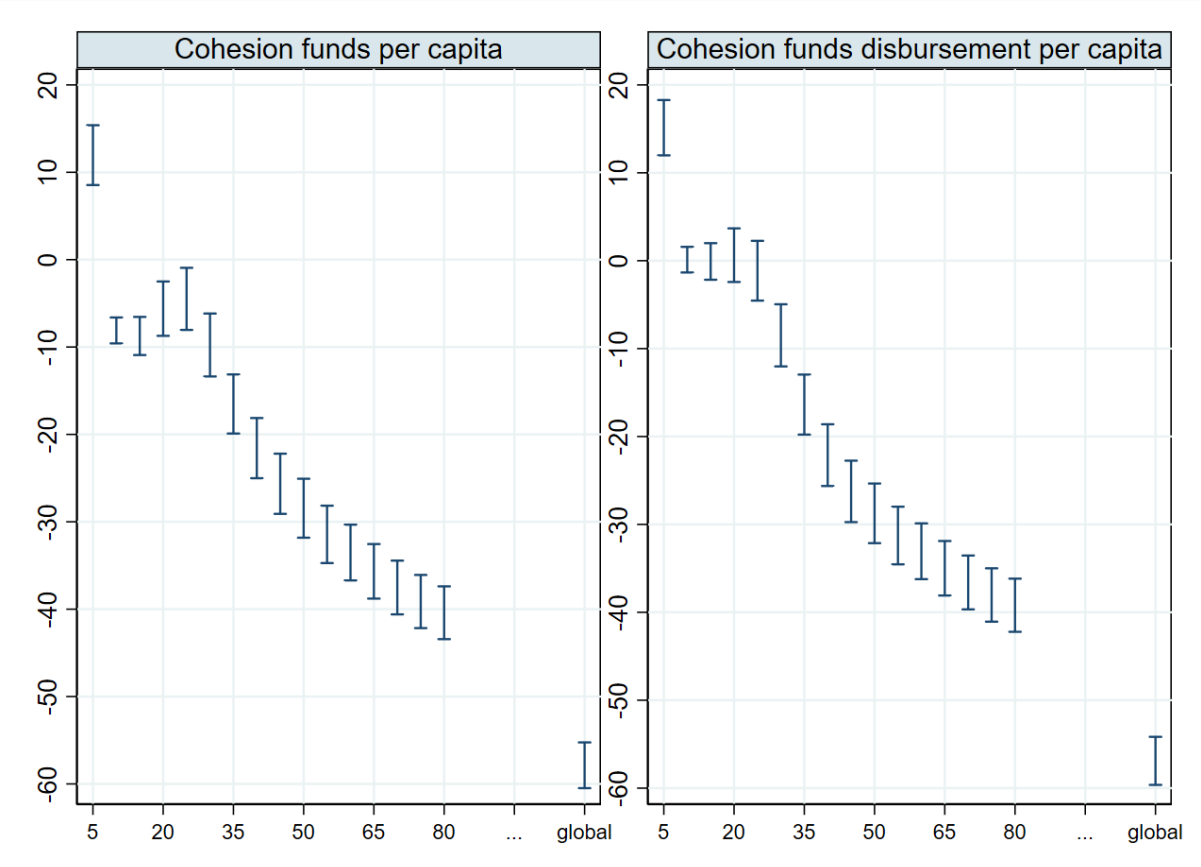
Appendix

Figure A.1: First-stage estimates of the instrument on two outcomes over varying bandwidths



Notes: The figure displays the first-stage regression results of the baseline specification where regional GDP per capita as a share of the EU average is the running variable and the outcomes are, in the left panel the modelled real per capita expenditures of EU funds, and in the right panel the sum of per capita disbursements from the EU funds.

Table A.1: Baseline with alternative outcome EU disbursements per capita

VARIABLES	(1) All sectors	(2) Public sector	(3) Public sector with pass-through	(4) Current government spending	(5) Private sector
Cohesion funds disbursement per capita	1.6107***	-0.1689***	-0.4555***	1.5967***	1.7796***
	(0.0630)	(0.0150)	(0.0181)	(0.1269)	(0.0710)
Robust 95% CI	[1.487 ; 1.734]	[-0.198 ; -0.139]	[-0.491 ; -0.42]	[1.348 ; 1.845]	[1.64 ; 1.919]
Kernel Type	Triangular	Triangular	Triangular	Triangular	Triangular
BW above/below	40/40	40/40	40/40	40/40	40/40
N above/below	2667/1363	2667/1363	2667/1363	2641/1234	2667/1363

Notes: The table presents the second-stage results from the baseline fuzzy RDD specification, where the outcomes are year-on-year changes in per capita investments in (1) all sectors, (2) the public sector, (3) the public sector subtracting ERDF and ESF funding, and (5) the private sectors. The outcome in (4) are year-on-year changes in per capita current government spending. Observations are at the level of NUTS-2 regions and years, and treatment is given by yearly regional per capita disbursements from the ERDF and ESF. Estimations include country and year fixed effects. The presented estimates are linear bias-corrected with robust nonparametric standard errors clustered at NUTS-2 level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Table A.2: Baseline with alternative treatment formal eligibility status

VARIABLES	(1) All sectors	(2) Public sector	(3) Public sector with pass-through	(4) Current government spending	(5) Private sector
Formal eligibility	63.7193***	-7.0829***	-17.9719***	60.5213***	70.8022***
	(2.8767)	(0.6879)	(0.6566)	(7.3837)	(3.0440)
Robust 95% CI	[58.081 ; 69.358]	[-8.431 ; -5.735]	[-19.259 ; -16.685]	[46.05 ; 74.993]	[64.836 ; 76.768]
Kernel Type	Triangular	Triangular	Triangular	Triangular	Triangular
BW above/below	40/40	40/40	40/40	40/40	40/40
N above/below	2667/1363	2667/1363	2667/1363	2641/1234	2667/1363

Notes: The table presents the second-stage results from the fuzzy RDD specification with the alternative treatment being the formal eligibility status. Outcomes are year-on-year changes in per capita investments in (1) all sectors, (2) the public sector, (3) the public sector subtracting ERDF and ESF funding, and (5) the private sectors. The outcome in (4) are year-on-year changes in per capita current government spending. Observations are at the level of NUTS-2 regions and years. Estimations include country and year fixed effects. The presented estimates are linear bias-corrected with robust nonparametric standard errors clustered at NUTS-2 level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Table A.3: Baseline with sharp RDD

VARIABLES	(1) All sectors	(2) Public sector	(3) Public sector with pass-through	(4) Current government spending	(5) Private sector
Above cutoff	-62.7597***	1.8706***	15.1767***	-76.5124***	-64.6303***
	(2.7468)	(0.5511)	(0.6708)	(3.1878)	(2.3334)
Robust 95% CI	[-68.143 ; -57.376]	[0.79 ; 2.951]	[13.862 ; 16.491]	[-82.76 ; -70.264]	[-69.204 ; -60.057]
Kernel Type	Triangular	Triangular	Triangular	Triangular	Triangular
BW above/below	40/40	40/40	40/40	40/40	40/40
N above/below	2597/1363	2597/1363	2597/1363	2577/1234	2597/1363

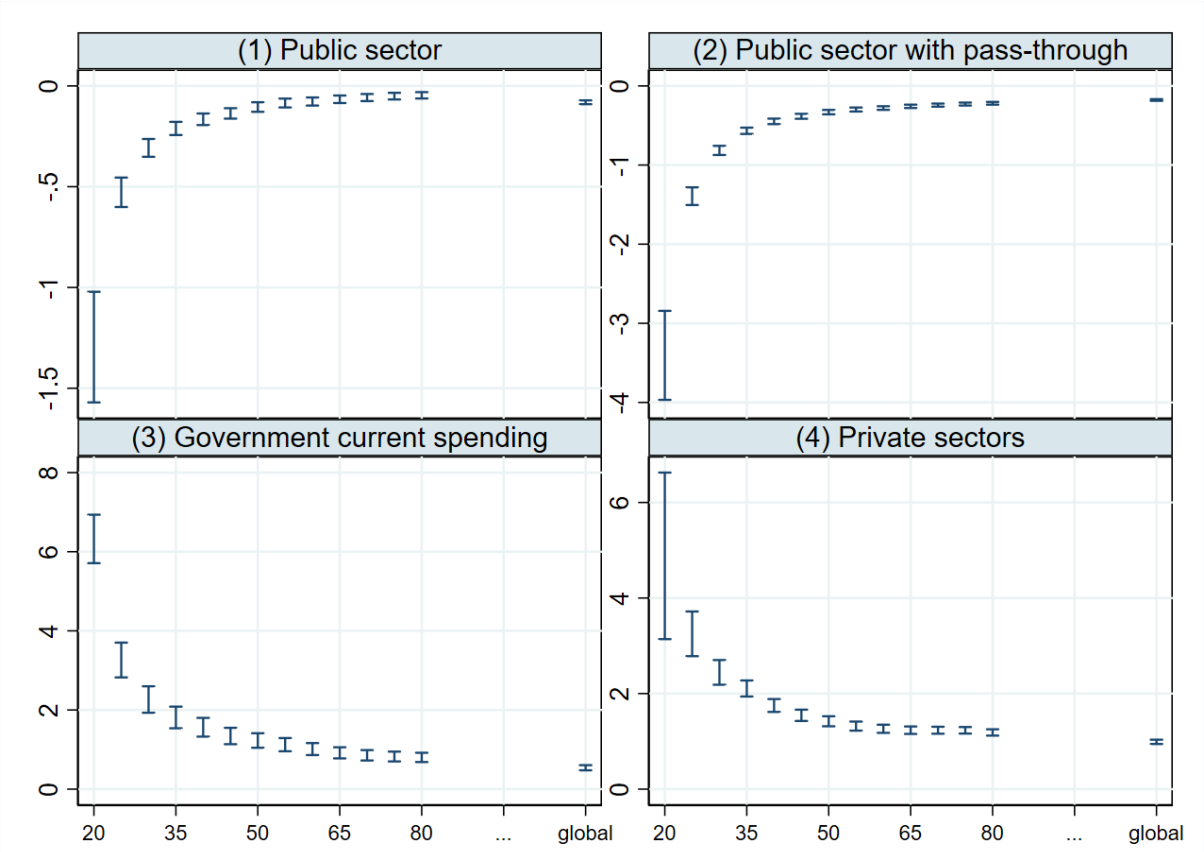
Notes: The table presents the results from the sharp RDD specification. The interpretation of the estimated coefficient is now the crossing of the eligibility threshold from below, which explains the reversal in sign of the coefficient. The running variable is regional GDP per capita as a share of the EU average and outcomes are year-on-year changes in per capita investments in (1) all sectors, (2) the public sector, (3) the public sector subtracting ERDF and ESF funding, and (5) the private sectors. The outcome in (4) are year-on-year changes in per capita current government spending. Observations are at the level of NUTS-2 regions and years. Estimations include country and year fixed effects. The presented estimates are linear bias-corrected with robust nonparametric standard errors clustered at NUTS-2 level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Table A.4: Baseline with region fixed effect

VARIABLES	(1) All sectors	(2) Public sector	(3) Public sector with pass-through	(4) Current government spending	(5) Private sector
Cohesion funds per capita	2.2339***	-0.0651***	-0.4583***	1.8926***	2.2990***
	(0.0504)	(0.0100)	(0.0128)	(0.0909)	(0.0540)
Robust 95% CI	[2.135 ; 2.333]	[-0.085 ; -0.045]	[-0.483 ; -0.433]	[1.715 ; 2.071]	[2.193 ; 2.405]
Kernel Type	Triangular	Triangular	Triangular	Triangular	Triangular
BW above/below	40/40	40/40	40/40	40/40	40/40
N above/below	2667/1363	2667/1363	2667/1363	2641/1234	2667/1363

Notes: The table presents the second-stage results from the baseline fuzzy RDD specification, where the outcomes are year-on-year changes in per capita investments in (1) all sectors, (2) the public sector, (3) the public sector subtracting ERDF and ESF funding, and (5) the private sectors. The outcome in (4) are year-on-year changes in per capita current government spending. Observations are at the level of NUTS-2 regions and years, and treatment is given by yearly regional per capita expenditures from the ERDF and ESF. Estimations include region and year fixed effects. The presented estimates are linear bias-corrected with robust nonparametric standard errors clustered at NUTS-2 level. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Figure A.2: Baseline over different bandwidths



Notes: The figure presents for bandwidth increments of 5 from 20 to 80 and for the global sample the second-stage coefficient and confidence interval from the baseline fuzzy RDD specification. Outcomes are year-on-year changes in per capita investments in (1) the public sector, (2) the public sector subtracting ERDF and ESF funding, and (4) the private sectors. The outcome in (3) are year-on-year changes in per capita current government spending. Observations are at the level of NUTS-2 regions and years, and treatment is given by yearly regional per capita expenditures from the ERDF and ESF. Estimations include country and year fixed effects. The presented estimates are linear bias-corrected with robust nonparametric standard errors clustered at NUTS-2 level. * (**) (***) indicates significance at the 10 (5) (1) percent level.