European Cohesion Policy in Mitigating Development Traps: The Role of R&D Intensity

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Introduction

Economists and policymakers increasingly recognize that relying solely on a one-dimensional metric is insufficient for understanding the complexities of economic and social progress (Stiglitz et al., 2018). The EU shares this view through the Beyond GDP initiative, yet GDP per capita remains the primary allocator of resources in the European Cohesion Policy (ECP), including in 2021–2027. Acknowledging this, existing empirical research predominantly evaluates the ECP through economic growth, providing an incomplete view of its multidimensional effects.

The ECP, however, extends beyond stimulating GDP growth. As the most extensive place-based regional policy globally, it encompasses interconnected objectives related to regional development, productivity upgrading and labor-market performance. These dimensions are central to the recent concept of the regional development trap introduced by Diemer et al. (2022), which evaluates regions based on changes in growth, productivity and employment relative to national and EU benchmarks. The risk of falling into such a trap is non-trivial across several Western European regions and remains elevated in many less-developed regions supported by Objective 1/Convergence Objective.

Although mitigating this trap is not an explicit objective of the ECP, the policy acts directly on the structural factors used to diagnose trap risk, making its effects relevant to examine. At the same time, prior evidence shows that ECP outcomes often depend on regional characteristics, suggesting similar conditionality here.

In this regard, research and development (R&D) intensity warrants particular attention. Since 2014–2020, the ECP has embedded R&D through thematic concentration on research, technological development and innovation, and through the Smart Specialisation Strategy (RIS3), creating an institutionalized link between ECP support and regional innovation capacity. This aligns with the view that escaping traps requires innovation-driven upgrading and with empirical work showing that R&D enhances growth, productivity and employment.

Therefore, this article addresses the following research question: "*Does Objective 1 support reduce regional development trap risk, and how is this effect conditioned by regional R&D intensity?*" By providing a causal, multidimensional assessment absent from earlier evaluations and documenting how effects vary with regional R&D intensity, the analysis contributes to debates on future ECP allocation design and advances broader policy discussions.

Related Literature

As Article 174 of the Treaty on the Functioning of the EU prioritizes reducing regional development disparities and the ECP targets these conditions, the policy's alignment with the

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structural dimensions of the development trap framework makes assessing its implications for trap risk particularly relevant.

First, ECP infrastructure funding reduces isolation in lower-income regions and facilitates productivity-enhancing investment (Ignatov, 2024). Empirical evidence, particularly from regression discontinuity design evaluations, shows that such support systematically contributes to regional growth (Crescenzi and Giua, 2020; Pellegrini et al., 2013). Second, in line with the Lisbon Strategy, the ECP additionally operates through digital and innovation-related investments that strengthen regional competitiveness and resilience (European Commission, 2024).

However, ECP-funded improvements that reinforce commuting and agglomeration patterns can contribute to brain drain from lagging regions. New economic geography and endogenous growth theory further indicate that agglomeration–innovation dynamics may conflict with the cohesion objective of reducing regional disparities (Farole et al., 2011).

In response to these agglomeration-driven concerns, the 2014–2020 shift to smart specialization linked ECP support directly to regional R&D capacity through RIS3 and thematic concentration, reflecting the key role of R&D in driving growth and aligning with the World Development Report 2024 “3i” strategy of investment, infusion and innovation. Moreover, extensive empirical evidence shows that R&D activity supports economic growth, sustains long-term productivity gains and contributes to employment creation, underscoring the importance of innovation-led technological change in regional development (Romer, 1990).

Given that R&D shapes growth, productivity and employment, its intensity is posited as the channel through which ECP support may impact regional development trap risk, consistent with its embedding in RIS3 and thematic concentration and with evidence on innovation-led upgrading in avoiding middle-income trap (e.g., Tung and Hoang, 2024). The identification strategy is detailed in the next section.

Methods and Data

The empirical strategy exploits the quasi-experimental setting created by the 75 percent GDP-per-capita threshold governing eligibility for Objective 1/Convergence Objective support. This discontinuity introduces quasi-random variation in treatment exposure, allowing local causal effects to be identified through a regression discontinuity design (RDD). To model systematic heterogeneity in these effects, the heterogeneous local average treatment effect (HLATE) framework of Becker et al. (2013) is applied, with treatment interacted with regional R&D intensity. Because eligibility does not perfectly determine treatment receipt, the analysis relies on a fuzzy RDD estimated via two-stage least squares. To avoid the sensitivity associated with higher-order polynomials, local linear and quadratic specifications are used around the cut-off. The HLATE is estimated using the following specification:

$$y_{ir} = \alpha + f_0(\tilde{x}_{ir}) + h_0(\bar{z}_{ir}) + T_{ir}[\beta + f_1^*(\tilde{x}_{ir}) + h_1^*(\bar{z}_{ir})] + \sum_{j=1}^{k} \gamma_j C_{jir} + \varepsilon_{ir} \quad (1)$$

where $f_0(\tilde{x}_{ir})$ and $f_1^*(\tilde{x}_{ir})$ capture the local polynomial trends in the running variable, $h_0(\bar{z}_{ir})$ and $h_1^*(\bar{z}_{ir})$ allow the effect to vary with R&D intensity (GERDpc), T_{ir} denotes treatment status, and C_{jir} the additional covariates.

The outcome variable is the regional development trap risk (RDT), computed following Diemer et al. (2022) from growth rates and accelerations in GDP per capita, productivity and employment, with the procedure adjusted to the length of the programming periods. The covariates include population density, age dependency, human capital and gross value added in manufacturing. The dataset covers NUTS-2 regions in the 2000–2006, 2007–2013 and 2014–2020 programming periods, using data from the European Commission, ARDECO and Eurostat. Regional units are harmonized across NUTS revisions to ensure consistency within and across programming periods.

Prior to the RDD analysis, the formal identification assumptions are verified: (i) the outcome exhibits a discontinuity at the 75 percent GDP per capita cut-off, (ii) covariates are continuous at the cut-off, (iii) the running variable shows no evidence of manipulation, and (iv) for the HLATE specification, the interaction variable (GERDpc) is also continuous at the cut-off.[1] The diagnostics validate the use of the fuzzy RDD with HLATE for identifying the causal and heterogeneous effects of the ECP.

Results and Discussion

Consistent with the HLATE approach, standard RDD estimates are first run separately for the two R&D-based subsamples. The resulting LATE effects vary across specifications: a clear causal ECP effect on reducing entrapment risk appears only under the linear form, whereas the quadratic specification is inconsistent. The effect is heterogeneous, stronger in the high GERDpc subsample, which highlights the need to account for R&D-related variation that can be efficiently captured through the full HLATE specification.

Table 1. Estimation results: ECP heterogeneity by R&D intensity

	Dependent variable: Risk of being trapped			
	HLATE		HATE	
	Bandwidth ±12.5%	*Bandwidth ±25%*	*IV-2SLS*	*Panel-IV*
Linear:	**(I)**	**(II)**	**(III)**	**(IV)**
Object1	-0.1372^{**}	-0.2424^{***}	-0.2743^{***}	-0.2520^{***}
	(0.0663)	(0.0540)	(0.0712)	(0.0786)
GERDpc X Object1	-0.6497^{***}	-0.6372^{***}	-0.5972^{***}	-0.6657^{***}
	(0.2253)	(0.2175)	(0.1902)	(0.2083)
Control variables	YES	YES	YES	YES
Regional FE	NO	NO	NO	YES
R^2	0.2642	0.1956	0.0613	0.1132
N	152	261	564	564
Quadratic:				
Object1	-0.1374^{*}	-0.2536^{***}	-0.2141^{**}	-0.1527
	(0.0706)	(0.0626)	(0.0841)	(0.0934)
GERDpc X Object1	-0.6603^{***}	-0.6694^{***}	-0.5657^{**}	-0.5737^{**}
	(0.2350)	(0.2454)	(0.2236)	(0.2469)
Control variables	YES	YES	YES	YES
Regional FE	NO	NO	NO	YES
R^2	0.2763	0.2215	0.0889	0.1283
N	152	261	564	564

Note: Standard errors clustered at the NUTS 2 level are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$.

[1] As an additional check, covariate continuity is likewise confirmed within the low- and high-R&D sub-samples.

For this reason, Table 1 reports the key HLATE estimates across the ±12.5 percent and ±25 percent bandwidths and for both linear and quadratic functional forms of the running variable, together with HATE estimates for the full sample with and without regional fixed effects (full results are available in the paper).

The results in Table 1 show that the heterogeneous effect is clear and consistently estimated. Across all specifications, the interaction between ECP support and GERD per capita is negative and statistically significant, indicating that the mitigating impact of the ECP systematically strengthens with higher R&D intensity. This aligns with prior evidence that ECP effectiveness depends on regional characteristics and shows that, beyond traditional economic outcomes, ECP support reduces entrapment risk in regions with higher GERD per capita. The mechanism suggests a synergistic effect in which R&D enhances technological progress, attracts private investment and supports productivity growth, increasing regional resilience. Conversely, regions with low GERD per capita benefit less, reflecting the innovation paradox observed in treated regions with limited R&D capacity.

At the same time, the direct effect of ECP support is generally negative but not uniformly confirmed. The effect weakens in the narrow bandwidth models, becomes only weakly significant in some cases, and is not significant in the panel IV specification with regional fixed effects (note: in the additional no-controls models, the direct effect is largely insignificant across alternative bandwidths). Although the controls do not exhibit consistent effects across specifications, some suggest plausible links to entrapment risk, for example through industrial structure or human capital.

Importantly, the heterogeneous ECP effect remains robust across linear and quadratic specifications, alternative bandwidths, the full sample, models with and without controls, and with or without regional fixed effects, and it also holds with an adjusted RDT excluding GDP per capita, confirming broader structural validity beyond any single indicator.

Conclusions

This paper contributes to the ECP literature by examining the policy's broader implications for mitigating the risk of a development trap in EU regions. Although the analysis does not identify a uniformly robust direct effect of the ECP on reducing entrapment risk, it consistently shows that its effectiveness becomes evident in regions with higher R&D intensity. Given this evidence and the current design of the ECP, it appears more appropriate to assess the policy not solely through economic growth or regional convergence, as these indicators may fail to capture its complex effects.

Moreover, the ECP's heterogeneous impact that emerges conditionally on R&D intensity, confirms the notion that fiscal policy effects are inherently context-specific. This has become a central principle in contemporary macroeconomic research, underscoring the need for interventions tailored to regional conditions. Accordingly, prioritizing R&D in treated regions could strengthen the ECP's multidimensional effects, particularly by supporting its causal role in reducing the risk of being trapped.

However, beyond empirical limitations (i.e., HLATE reflects local, not universal impacts), a narrow focus on increasing R&D alone may not yield the desired outcomes due to systemic deficiencies, which are also evident in the deepening innovation divide within the EU.

Therefore, further analyses are required, particularly to investigate the factors driving this divide between leading and lagging EU regions.

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