

Public Catalyst or Private Substitute? Decomposing the GDI to Analyze the Efficiency of EU Green Funds in the V4 Region

1. Introduction The European Green Deal requires an unprecedented mobilization of capital. For the CEE region, EU funds—specifically the Recovery and Resilience Facility (RRF) and Cohesion Funds—represent the primary "green resources." However, the long-term goal of these funds is not to subsidize the transition indefinitely but to de-risk markets and attract private capital. This study connects the Green Dedicated Investment (GDI) framework with the debate on the efficiency of public finance. We move beyond measuring the *volume* of investment to analyzing its *source structure*. By distinguishing between public (GDI_{pub}) and private (GDI_{priv}) components, we aim to understand the financial sustainability of the green transition. Our core question is: Are EU funds acting as a catalyst for private GDI, or are they merely substituting for it?

2. Theoretical Framework: Catalyst vs. Substitution

The economic theory of "crowding-in" suggests that public investment in green infrastructure (e.g., grid upgrades, charging networks) increases the profitability of private investments, thereby stimulating private capital flows. Conversely, "crowding-out" or "substitution" occurs when public funds replace private expenditure, often due to subsidized interest rates or grant dependency.

In the context of the GDI, a healthy transition should show a rising GDI_{priv} in response to GDI_{pub} . If GDI_{total} rises while GDI_{priv} stagnates, the region is in a "subsidy trap." We define the "Green Multiplier" as the ratio of induced private GDI to public green spending.

3. Methodology: Decomposing the Indicator

We refine the GDI formula introduced in previous studies to explicitly separate funding sources:

- **$GDI_{total} = GDI_{pub} + GDI_{priv} + GDI_{mixed}$**
 - **GDI_{pub} :** Direct climate-related disbursements from EU funds (CF, ERDF, RRF) and national budget expenditures.
 - **GDI_{priv} :** Corporate green CapEx (derived from eGDI data) and green FDI inflows, excluding state-subsidized portions.
 - **GDI_{mixed} :** Projects utilizing blended finance (e.g., guaranteed loans).
- **Analysis:** We employ a panel vector autoregression (PVAR) model on NUTS2 regions in the V4 countries (2018–2024) to test the Granger causality between public fund inflows and private investment decisions.

4. Empirical Results: The Dual-Speed Financing Model

The decomposition of GDI data reveals significant structural weaknesses in the region's green financing.

- **The "Crowding-in" Success Stories:** In capital regions and established industrial clusters (e.g., Central Hungary, Mazovia), we observe a strong positive correlation ($r > 0.6$) between EU funding and subsequent private GDI. Here, public funds effectively

de-risk new technologies (e.g., hydrogen pilots), attracting massive private follow-up investment. The "Green Multiplier" is greater than 1.

- **The "Substitution" Problem:** In less developed regions, the correlation is weak or negative. High inflows of EU funds coincide with low or stagnant private GDI. In these areas, green projects are almost exclusively state-driven (e.g., public building renovation, municipal transport). Private capital remains risk-averse, viewing these regions as unviable without 100% subsidies. This creates a fragility in the GDI: if EU funds were to stop, the green transition would collapse.
- **Sectoral Distortions:** The analysis shows that "Hard" resources (machinery, infrastructure) attract more private capital than "Soft" resources (R&D, human capital), suggesting a bias toward physical asset accumulation over innovation.

5. Discussion: From Absorption to Leverage

The findings challenge the traditional metric of "absorption capacity" used in EU policy. High absorption of green funds (high GDI_{pub}) is not a success metric if it fails to trigger private leverage.

The "turbulent times" of high interest rates (2022–2024) exacerbated this issue, as private capital became more expensive, increasing the reliance on cheap public funds. However, fiscal sustainability requires a shift.

Policy Implications:

- **Conditional Grants:** Grants should be increasingly replaced by financial instruments (guarantees, equity) in mature regions to force private participation.
- **De-risking Instruments:** In laggard regions, public funds should focus on removing specific barriers to private entry (e.g., grid capacity bottlenecks) rather than funding generic projects.

6. Conclusion

The GDI framework provides a powerful lens to view not just *how much* we invest in the green transition, but *who* pays for it. This study demonstrates that for the V4 region, the current reliance on public green resources is unsustainable. The future of regional resilience lies in transforming the GDI from a subsidy-driven index to a market-driven indicator of competitiveness.