

From Periphery to Node: Regions' Position, Function, and Dependence in the Era of the Triple Transition (Green, Digital, and Geopolitical)

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Background and motivation

The economic geography of European regions is entering a transition era in which competitiveness can no longer be explained adequately by sectoral structure, wage costs, or incremental productivity alone. Three shifts increasingly redefine regional performance and the mechanisms that produce it. First, green reindustrialization is reorganizing value chains around decarbonization, electrification, circularity, and carbon-accounting regimes, pushing firms and governments to secure clean energy, meet tighter standards, and reconsider location decisions. Second, digital phantomization accelerates the partial detachment of value creation and control from locally visible production, as platforms, cloud and AI services, and compliance technologies allow high-value functions such as coordination, validation, and monetization to be performed at a distance while material production remains distributed. Third, geopolitical fragmentation raises the salience of strategic dependencies, export controls, sanctions, sanctions-compliance, and security screening, making market access, technology transfer, and even payment channels more conditional and governance-intensive. In this context, regions succeed not only through what they produce, but through how they are positioned in networks, which functions they perform within strategic flows, and which dependencies they accumulate, manage, or transform.

Aim and contribution

This paper proposes and tests a Position–Function–Dependence (PFD) framework for understanding regional performance in the era of the triple transition. It advances three propositions. First, position is a relational asset: regions benefit from greater centrality and accessibility in transport, trade, innovation, and connectivity networks. Second, function is a role-based advantage: regions capture more value and strategic autonomy when they perform node-like roles that mediate flows and govern access to markets, standards, finance, and data. Third, dependence is a constraint and risk: exposure to external energy inputs, critical technologies, finance and currency regimes, and external rule-making power reduces room for manoeuvre and amplifies vulnerability to shocks. The paper contributes by translating these concepts into measurable indicators, assembling them into a composite PFD profile for EU regions, and evaluating whether PFD configurations outperform conventional predictors in explaining growth, resilience, and adjustment capacity. Beyond explanation, the framework is designed as a diagnostic tool: it identifies where a region's bottleneck is positional, functional, or dependency-based, thereby enabling policy to target the binding constraint rather than applying generic cohesion or competitiveness measures.

Conceptual framework and operationalization

Position is operationalised as network centrality and accessibility across strategic infrastructures and flows. It is measured through indicators capturing multimodal transport accessibility, proximity to major corridors and gateways, effective travel-time to markets, and

proxies for integration into trade, value-chain, and innovation networks, complemented by measures of digital connectivity and connectivity quality. Importantly, position is treated as a relational property rather than a geometric one: the same geographic location can become more or less “central” as networks, regulations, and technologies reconfigure flows.

Function is captured through role-based indicators that differentiate gateway regions, processing hubs, R&D nodes, and validation or compliance centres. This dimension distinguishes production-based participation from node-like mediation. Gateway roles capture entry and exit points for goods, energy, and sometimes data; processing hubs capture transformation and assembly; R&D nodes capture knowledge production and recombination; validation and compliance centres capture the institutional and service capabilities that enable certification, standard compliance, traceability, auditing, legal-financial intermediation, and other governance-intensive functions. In the triple transition these mediation functions become disproportionately valuable because decarbonization and geopolitics increase the importance of compliance and traceability, while digital systems increase the returns to orchestration, coordination, and control.

Dependence is measured as exposure to external control points that condition a region’s capacity to sustain development trajectories under shock and policy turbulence. The dependence dimension is decomposed into energy dependence (external supply exposure and price vulnerability), technology dependence (reliance on externally controlled critical technologies and inputs), finance and currency dependence (external financing reliance, ownership structures, exposure to monetary and risk regimes), and rule or standards dependence (distance from standard-setting, compliance burdens, and limited capacity to shape rules). Dependence is not treated as uniformly negative; the analysis distinguishes enabling integration (dependencies that support upgrading) from lock-in dependencies (dependencies that reproduce low autonomy and limit learning).

Data, scope, and empirical strategy

Empirically, the study constructs a composite PFD profile for EU regions at NUTS2 level, complemented by selected NUTS3 deep-dives where gateway effects and functional specialisation are spatially concentrated. The analysis proceeds in four steps.

First, P, F, and D indicators are harmonized, normalized, and aggregated into sub-indices and composite regional profiles, with robustness checks across alternative weighting and normalization schemes. Second, the paper develops a typology of regional roles by clustering PFD profiles, producing interpretable groups such as gateway mediators, processing peripheries, hybrid production–gateway regions, R&D nodes, validation centres, and mixed-function hubs. Third, the explanatory power of PFD profiles is tested against conventional predictors such as GDP per capita, sectoral shares, investment intensity, and human capital proxies, using outcomes that capture growth performance, resilience to shocks, and adjustment capacity. Fourth, the methodology combines network metrics with spatial and/or panel regression to account for spatial dependence, spillovers, and path dependency, and to test whether position and function exert effects beyond sectoral composition, while dependence conditions or weakens these effects. The empirical focus is not only on average effects but on configurations, the paper tests whether certain combinations (for example, high position plus upgraded functions under manageable dependence) systematically predict stronger resilience and post-shock recovery.

Comparative case windows from Southeast Europe

To complement the EU-wide typology, the paper includes two comparative “case windows” from Southeast Europe to illustrate plausible pathways from production-based participation toward node-like roles. One window examines a metropolitan-capital region where institutional density, research ecosystems, and connectivity can enable the accumulation of R&D and validation functions, demonstrating how digital and governance capacities can upgrade regional roles even in the absence of dominant manufacturing. The second window examines a corridor, port, or border-gateway region, showing how gateway position can be leveraged for higher-value mediation such as logistics orchestration, compliance and traceability services, and energy transition infrastructure, rather than remaining confined to low-margin transit or assembly roles. These windows are used to show how changes in policy, infrastructure, and institutional capability translate into observable shifts in PFD profiles, and why “catch-up” is better conceptualised as role transformation than as simple sectoral convergence.

Expected results and policy implications

The paper delivers a typology of regional roles in the triple transition and provides evidence that PFD configurations account for meaningful differences in growth, resilience, and adjustment capacity beyond conventional sectoral and investment predictors. Regions that combine strong position with node-like functions and manageable dependencies are expected to exhibit greater resilience and a higher capacity for strategic adjustment during shocks, while regions with similar sectoral structures but weaker functional roles may remain vulnerable and value-capturing constrained. The policy implications shift from generic competitiveness measures toward role-upgrading strategies. This includes upgrading functions toward orchestration, innovation, traceability, and compliance; investing in connectivity that changes centrality and accessibility rather than only capacity; reducing harmful energy, technology, financial, and rule dependencies through diversification and capability building; and strengthening institutional capacity that enables regions to navigate, comply with, and selectively shape evolving standards and conditional market access. The framework also supports differentiated cohesion policy rather than uniform prescriptions, it specifies which interventions are likely to move a region from periphery to node given its current PFD bottlenecks.

Keywords

Economic geography; regional development; triple transition; network centrality; functional upgrading; strategic autonomy; dependence; EU regions; NUTS2; resilience.