

Extended Abstract

Making Sense of the Twin Transition: A Gioia-Based, LLM-Enhanced Analysis of European Labour-Market Policies

Introduction

The twin (green and digital) transition has emerged as a central organising principle of contemporary European governance (European Commission, 2019; 2020a; 2020b). The European Green Deal, the Digital Strategy, the European Skills Agenda, and Recovery and Resilience Plans collectively frame structural transformation as a dual imperative: decarbonising economies while accelerating digitalisation. Labour markets and skills systems sit at the heart of this agenda. They are expected to absorb technological disruption, facilitate industrial restructuring, and ensure social inclusion in the face of rapid change (Dawley et al., 2025; Moilanen et al., 2024; OECD, 2021).

Yet, despite the proliferation of strategies and policy instruments, limited attention has been paid to how policy actors themselves conceptualise labour markets and adjustment challenges under the twin transition (Haas & Sabel, 2022; Mazzucato & Kattel, 2020). Do European institutions, national governments, and regional authorities frame labour markets as competitiveness enhancing assets, as social protection systems, or as arenas of structural reallocation (Thelen, 2014; Amable, 2003)? How coherent are these framings across governance levels? And to what extent do institutional complementarities, or mismatches, shape policy coherence (Flanagan et al., 2011; Crescenzi et al., 2022)?

Therefore, the main research question is: How do European, national, and regional policy actors conceptualise labour markets, skills, and adjustment challenges in the context of the twin transition, and how coherent are these conceptualisations across governance levels and geographies of Europe?

Theoretical framing: Policy coherence and institutional complementarity in the twin transition

Structural transformation is path-dependent and institutionally mediated (Martin & Sunley, 2006; Boschma, 2017). Boschma (2017) argues that regional diversification depends on relatedness and institutional capacity. While the role of technological capabilities in shaping regional opportunities in the twin transition demonstrates that the transformation is uneven across space and contingent on pre-existing capabilities (Bachtrögl-Unger et al., 2023; Balland et al., 2019).

However, technological capabilities alone do not guarantee successful adjustment. Institutional complementarity, the degree to which policy domains reinforce one another, plays a critical role (Amable, 2003; Hall & Soskice, 2001; Boschma, 2025). Institutional complementarity suggests that labour-market institutions, education systems, industrial

policy, and innovation governance must align to generate coherent transformation pathways (Flanagan et al., 2011; Crescenzi et al., 2022). In fragmented systems, misalignment across policy domains can undermine transformation even when technological potential exists (Rodríguez-Pose & Di Cataldo, 2015).

Policy coherence becomes especially salient in the European multi-level governance architecture. At the supranational level, the EU sets strategic direction through missions and regulatory frameworks (Mazzucato, 2018). At the national level, governments translate these priorities into labour-market reforms, training systems, and industrial strategies. At the regional level, smart specialisation strategies operationalise transformation according to territorial capabilities.

Policy coherence becomes especially salient in the European multi-level governance architecture (Bache & Flinders, 2004; Hooghe & Marks, 2001). At the supranational level, the EU sets strategic direction through missions and regulatory frameworks (Mazzucato, 2018; Mazzucato & Kattel, 2020). At the national level, governments translate these priorities into labour-market reforms, training systems, and industrial strategies. At the regional level, smart specialisation strategies operationalise innovation-led structural transformation by prioritising domains where regions have distinctive territorial assets and capabilities and strengths identified through an entrepreneurial discovery process (Foray, 2014; McCann & Ortega-Argilés, 2016; Boschma, 2015).

The twin transition, thus, represents a test of institutional alignment across governance scales. If labour markets are framed differently at EU, national, and regional levels, coordination problems may emerge (Crescenzi et al., 2022). Moreover, differences across European socio-economic models (e.g. Nordic, Continental, and Mediterranean) (Sapir, 2006; Amable, 2003) and the distinct institutional configuration of Central and Eastern Europe (Nölke & Vliegenthart, 2009; Bohle & Greskovits, 2012) may produce divergent interpretation of labour market adjustment (Thelen, 2014). Therefore, this paper treats labour-market governance not as a passive outcome of technological change, but as an active arena where directionality, distribution, and legitimacy are negotiated (Schot & Steinmueller, 2018; Mazzucato, 2018).

Data and methods

This paper develops a multi-level policy mapping of the twin (green and digital) transition and its labour-market implications across Europe. The study constructs a structured database of policy instruments at supranational, national, and regional levels in order to analyse how skill formation, employment governance, and labour-market adjustment are embedded within Europe's transformation agenda. The unit of analysis is the individual policy instrument, including communications, regulations, directives, council recommendations, action plans, monitoring frameworks, and programme documents. Each instrument is coded as a structured observation in a harmonised masterfile.

The dataset covers three governance scales. At the supranational level, documents were collected from the European Commission, Council, and related bodies, including instruments linked to the European Green Deal, Digital Strategy, European Skills Agenda, Just Transition Mechanism etc (European Commission, 2019; 2020a; 2020b). At the national level, at least ten documents per country were identified, including Recovery and Resilience Plans, national skills strategies, green transition roadmaps, digital transformation strategies with labour components, and active labour-market reforms (European Commission, 2021). At the regional level (NUTS2 or NUTS3 depending on administrative competence), Smart Specialisation Strategies, Just Transition Plans, regional innovation strategies, and territorial skill ecosystem initiatives were included where labour-market relevance was present (Foray, 2014; Boschma, 2015).

Policy identification followed a structured inclusion strategy combining keyword filtering (e.g., “twin transition”, “green skills”, “digital skills”, “reskilling”, “labour shortages”), backward and forward tracing within major policy frameworks, and a substantive relevance threshold requiring explicit linkage between transformation objectives and labour-market or skills governance mechanisms. Purely environmental or purely technological strategies without labour implications were excluded. Each document was coded using a harmonised framework capturing policy type, binding character, governance mode, twin focus, labour-market framing, labour mechanisms (e.g. upskilling, reskilling, activation, migration, funding), target groups, sectoral focus, and territorial targeting.

To move beyond the descriptive cataloguing, the analysis applies an adapted Gioia methodology to policy texts (Gioia et al., 2013). First-order concepts were extracted directly from policy language (e.g. “fair green transition”, “skills intelligence”, “micro-credentials”, “industrial ecosystems”, “resilience”). These were aggregated into second-order themes such as transformation governance, skill ecosystem coordination, labour-market resilience, institutional complementarity, and territorialised transition strategies. Finally, aggregate dimensions were constructed to capture overarching governance architectures of the twin transition.

Large Language Models (LLMs) were used as structured analytical assistants to extract recurring concepts, propose preliminary coding, and organise textual material under predefined categories. Their use follows emerging methodological discussions on AI-supported qualitative analysis (Bail, 2023; Leonelli, 2023). All outputs were manually validated and iteratively refined to ensure consistency and theoretical alignment. The LLM-supported process enhanced transparency and scalability while preserving interpretative control.

The resulting dataset enables comparative analysis of policy coherence across governance levels, identification of institutional complementarities between green, digital, and labour policies, and construction of typologies of European transition

governance. By systematically linking transformation strategies to labour-market adjustment mechanisms, the study provides an empirical foundation for assessing how regions and countries build resilience under conditions of structural change (Martin & Sunley, 2015; Dawley et al., 2025).

Preliminary results

Drawing on Boschma's (2017) argument that diversification depends on relatedness and institutional capacity, the analysis shows that the twin transition unfolds unevenly across Europe due to differences in institutional complementarity across governance scales. Regions and countries where industrial strategy, skill systems, labour-market institutions, and innovation governance are aligned are likely to display more coherent transition narratives, framing labour markets as adaptive systems enabling related diversification into green and digital domains. In such contexts, labour market policy is expected to be integrated with smart specialisation priorities and industrial ecosystems, reflecting mutually reinforcing policy mixes (Flanagan et al, 2011).

Conversely, where complementarities are weak and policy domains operate in silos, the mapping reveals fragmented adjustment logics, with skill policies decoupled from technological priorities and social protection disconnected from transformation strategy. These misalignments may limit the capacity to translate technological relatedness into sustained structural transformation. The findings therefore support the theoretical claim that successful twin-transition governance depends not only on technological capabilities but on the degree of institutional complementarity aligning labour-market adjustment with innovation and industrial transformation across Europe's multi-level governance system.

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