

Technological Innovation and Regional Resilience: a Composite Index approach to assess Regional Vulnerability

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Abstract

Despite many years of social scientific research into innovation and emerging technologies, and their recent rise in the public and political ‘visibility’, key researchers such as Autor (2024), Acemoglu, Restrepo (2019) and Goos (2018) continue to argue that our understanding of the future impacts of new technologies remains limited. Dorn (2015) questions whether technological progress will continue at the same rate or are we reaching a saturation point in the next years. In this era of constant transitions and transformations, consumer expectations and the ongoing environmental pressure, along with the increasing globalisation, are redefining the competitive environment in which firms operate (Song et. al, 2022). Within this scenario, innovation is no longer an option, it is a necessity. In recent years, the increasing spread of new digital technologies has radically transformed the competitive environment in which companies operate (Brynjolfsson and McAfee, 2014). Emerging technologies, such as artificial intelligence and automation, are redefining how we work, learn and relate. These dynamics are highly relevant, as they play a crucial role in both the ongoing economic transformation and efforts to maintain social and territorial cohesion (European Commission). The European Commission, among its main activities, promotes the implementation of cohesion policies in order to stimulate competitiveness, innovation and green and digital transition also at regional level. In this regard, it clearly confirms the existence of significant regional gaps within the European Union, and cohesion policies are one of the main instruments to address them. The idea that regions develop unevenly is not new (Myrdal, 1957). In fact, regions have always been characterised by different economic and structural systems. These differences are related to many aspects, including employment, environment, infrastructure and so on. This phenomenon has also been amplified by increasing globalisation (Puga, 2002; Autor et. al, 2013). Indeed, Sassen (2001) notes that globalisation favours the concentration of wealth and innovation in large cities and metropolitan areas, creating strong regional disparities. Rodriguez-Pose, Tomaney (2006) confirm how globalisation has made inequalities between regions more visible. However, even where cohesion policies act (e.g. EU structural funds), the reduction of regional disparities is slow and uncertain (European Commission, 2024). Alexopoulos et al. (2025) analysed the effects of the EU Cohesion Fund and the results indicate that the positive effects are concentrated in the first seven years after a region’s

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inclusion in the programme, but with an uneven distribution where poorer regions tend to benefit more, while richer ones show smaller effects. Even though progress has therefore been made in reducing disparities, significant differences within countries persist (OECD, 2016). Within this context, the risk that the process of technological innovation accentuates existing regional gaps, making some areas more vulnerable in terms of innovation and development, must be considered. While most of the literature has focused more on the impact of technology at the macroeconomic level (Aghion, Howitt, 1994; Acemoglu et. al, 2000), mainly considering impacts on GDP and employment, this study aims to provide a more detailed perspective for geographical areas where we already find important foundations of some research (Saxenian, 1994; Boschma, 2005; Moretti, 2012; Rodríguez-Pose, 2013; Iammarino et. al, 2020) expandable for future academic debate. These presented studies highlight two fundamental aspects. Firstly, new technologies risk increasing inequalities by creating a new “geography of vulnerability” in which some regions respond better than others. Numerous works in the literature show how European regions have reacted differently over the years to exogenous shocks and crises (Crescenzi et. al., (2016); Martin et. al., 2016; Bristow, Healy, 2018; Faggian et al., 2018). Regional resilience also depends on institutional, social and local governance factors (Sensier et. al., 2016). While in some regions economic and educational progress will provide new opportunities, others may be more affected. Secondly, regional disparities mean that regions respond differently to external shocks caused by technology (Martin R, 2012). The ability of a region to respond to exogenous shocks is a fundamental concept, referred to as economic resilience, and represents the readiness and effectiveness with which an area is able to absorb, adapt to and recover from unforeseen external events. An authoritative theoretical framework is provided by Martin and Sunley (2015) in which they define the four dimensions of regional resilience: resilience, recovery, reorientation and renewal. It is therefore evident that the impact of technological innovation within the labour market remains a central concern within the scientific community, with several critical issues yet to be resolved. Several contemporary scholars point out that there are substantial gaps in our understanding of technological evolution, particularly with regard to artificial intelligence and automation (Acemoglu, 2023; Brynjolfsson, McAfee, 2014; Autor, 2015). Autor (2024) argues that the direction that new technologies take will depend mainly on political, institutional and cultural choices, not necessarily on technological fate. New technologies don’t have a predetermined fate and require extensive redevelopment. In order to respond, it is important to propose new training paths and investments that lead to the achievement of complementarity between human labour and AI (OECD, 2022). For this reason, it will be crucial monitor and evaluate the socio-economic impacts of new technologies, through the assessment of the effectiveness of public policies in order to propose adaptive and responsive frameworks, with a specific attention to sustainability and equity. Considering this scenario, this research project aims to analyse how the introduction of new emerging technologies in the labour market, particularly automation and artificial intelligence (AI), can impact the economic resilience at the regional level. Despite the extensive literature on the impacts of automation and AI in relation to regional economic resilience, there is a lack of an integrated framework linking the responsiveness of territories with the divergent effects of new technologies. This study uses a composite index approach to classify regions in terms of vulnerability and investigate the impacts of new technologies in the main sectors. The analysis intends to consider six components within the index: economic structure, labour market, financial system, governance and institutions, economic performance, environmental factors and sustainability. The derived outputs will define a regional vulnerability parameter useful

for classifying regions with the aim of expressing the stages of resilience described by Martin and Sunley (2015) for those regions that lag behind. Although there are well-known studies in the literature that use the composite index as a methodological tool, those usually have many indicators or are based on indicators already developed at European level (e.g. RCI). The index proposed in this study is characterised by a more selective process useful to analyse the adoption of new technologies. In addition, this study is useful to provide differentiated policy recommendations for different geographical areas, which are often generic or aggregated by broad categories. The analysis will focus within the European Union (NUTS-2 regions) and will reveal: (i) the impacts of technological innovation at regional level, considering the significant heterogeneity of territories and key sectors (ii) the importance of regional policies for economic resilience and new differentiated guidelines.