

Mapping Research on European Structural and Investment Funds, Innovation and Economic Growth: A Bibliometric Analysis

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Abstract

European Structural and Investment Funds (ESIF) are the primary financial instrument of EU cohesion policy. Despite their central role in supporting innovation activity and economic growth, the literature remains fragmented across four distinct research traditions, namely evaluative-econometric, macroeconomic, regional-innovation and institutional-political. This paper employs bibliometric analysis to examine the intellectual foundations, thematic structure and developmental dynamics of the ESIF, innovation and economic growth research field. Bibliometric analysis of 305 documents (Web of Science, 1991 to 2026) was conducted using Bibliometrix and Biblioshiny, integrating performance analysis with science mapping. We identify four intellectual traditions that, despite sharing a common object of inquiry, operate in largely separate citation networks.

This intellectual fragmentation may contribute to the persistence of heterogeneous and hard to compare findings regarding ESIF effectiveness. The absence of a dominant motor theme suggests that the field is methodologically mature yet thematically unconsolidated, underscoring the urgent need for deeper synthesis of accumulated knowledge. We further find a geographical asymmetry in the analysed dataset, with research on ESIF concentrated on countries where the funds carry comparatively limited direct economic consequences, while Central and Eastern European countries, where ESIF have the most immediate impact, have a relatively limited presence. The analysis further identifies a phased developmental trajectory that coincides with EU cohesion policy programming cycles (annual growth rate of 4.04%), suggesting that research production may be partly responsive to EU cohesion-policy programming cycles rather than driven solely by endogenous scientific inquiry.

Keywords: European structural and investment funds, cohesion policy, regional innovation, economic growth, bibliometric analysis.

JEL Classification: O30; O40; R11; R58.

Introduction

Capital accumulation and factor expansion alone are insufficient to account for the economic growth patterns observed in advanced economies. Innovation, institutional quality and the capacity to allocate resources where returns are highest carry equal if not greater explanatory weight. The European Union addresses these challenges under particularly demanding conditions, marked by persistent regional disparities and a policy agenda increasingly oriented towards knowledge-based development. European Structural and Investment Funds (ESIF) offer a compelling object of scholarly inquiry precisely because their substantial financial transfers are explicitly tied to the objectives of regional convergence and innovation support, making them a natural laboratory for examining the intersection of public investment policy, institutional capacity and regional economic performance.

The existing literature on the relationship between ESIF, innovation and economic growth is extensive yet fragmented. Empirical studies broadly confirm the positive effect of ESIF on regional growth through infrastructure investment and innovation support, although the magnitude and conditionality of this effect vary considerably across contexts. Meta-analytical evidence (Dall'Erba and Fang, 2017) demonstrates that findings are strongly sensitive to methodological choices, time horizons and the types of regions under study. Despite a growing volume of publications, a systematic mapping of the field's development over time, its thematic contours and prevailing methodological approaches remains absent, precluding a comprehensive synthesis of accumulated knowledge. Part of this heterogeneity may arise not from genuine disagreement about the underlying economic reality, but from differences in how effectiveness itself is defined and measured across studies. Reconciling these findings therefore requires disentangling substantive contextual heterogeneity from divergence in definitional and methodological choices.

The aim of this paper is therefore to identify the main trends and directions of research on ESIF, innovation and economic growth through bibliometric analysis. Specifically, we focus on identifying the key research streams, the most influential authors and publications, and the dominant thematic clusters. The bibliometric approach provides a comprehensive overview of the temporal evolution of the field and enables empirical verification of what have hitherto been largely descriptive claims about its fragmentation.

The present paper contributes to existing literature in three ways. First, in contrast to existing narrative reviews (Nishimura et al., 2021) and meta-analytical studies narrowly focused on regional growth (Dall'Erba and Fang, 2017), it provides quantitative network mapping of the entire research field linking ESIF, innovation and economic growth. Second, by employing a combination of performance analysis and four network methods, namely co-authorship analysis, co-citation analysis, bibliographic coupling and co-word analysis, it empirically validates what have hitherto been largely descriptive claims about the field's fragmentation, while identifying its intellectual pillars, collaborative architecture and thematic clusters. Third, drawing on an extended time horizon spanning 1991 to 2026, it captures not merely a static portrait of the field but its developmental dynamics, including more recent thematic shifts towards sustainability, smart specialization and regional inequalities. These insights carry value both for researchers navigating a rapidly evolving field and for policymakers who require robust evidence on the effectiveness of cohesion policy in shaping the design of forthcoming programming periods.

The paper is structured as follows. The first section reviews the current state of knowledge on ESIF, innovation and economic growth and establishes the theoretical foundations. The second section describes the methodological framework of the bibliometric analysis and the sample selection procedure. The third section presents the results alongside the accompanying discussion. The concluding section summarizes the main findings and outlines directions for future research.

1. Literature Review

Research on the relationship between ESIF, innovation and economic growth has been the subject of extensive theoretical and empirical inquiry over recent decades. The following review distinguishes three interrelated strands: (i) theoretical models of economic growth and the role of innovation, (ii) empirical research on the impact of ESIF on growth and convergence, and (iii) studies examining the institutional and regional conditions of ESIF effectiveness.

The relationship between economic growth and innovation performance is among the oldest themes in economic theory. The role of innovation as a driving force of development was emphasized as early as Schumpeter (1942) through the concept of creative destruction (Ziemnowicz, 2013). However, the Solow growth model (Solow, 1956) treated technological progress as an exogenous factor, which prevented it from adequately accounting for the persistent differences in growth rates observed across countries.

A fundamental shift was brought about by endogenous growth theory. Romer (1986, 1990) demonstrated that knowledge capital exhibits increasing returns and diffuses across firms as a positive externality. In a parallel strand, Lucas (1988) emphasized the role of human capital. Aghion and Howitt (1992) formalized Schumpeter's intuition about creative destruction into a model in which growth is generated by vertical innovations. Aghion et al. (2014) further developed this approach, highlighting the role of competition, firm dynamics and the institutional environment.

Acemoglu et al. (2018) extend the endogenous growth framework to the firm level, demonstrating that aggregate growth depends not only on the intensity of innovation investment but also on the mechanism of resource reallocation. From a broader institutional perspective, Acemoglu et al. (2005) argue that economic institutions constitute the fundamental cause of long-run differences in economic performance across countries. For the purposes of this paper, the common denominator is clear: economic growth is the outcome of

the accumulation of multiple complementary forms of capital, each requiring targeted financing. Cameron et al. (2005) show that access to investment resources is indispensable for the accumulation of knowledge capital and the diffusion of technology, a role that at the level of European regions is fulfilled by cohesion policy and its primary instrument, ESIF.

European Structural and Investment Funds are the primary instrument of EU cohesion policy, designed to promote economic growth and reduce regional disparities (Nishimura et al., 2021).

Vukašina et al. (2022) demonstrate, on a sample of EU-12 countries, a statistically significant though economically modest positive association between ESIF absorption and regional development. Blazhko et al. (2025) confirm strong positive correlations between ESIF expenditure and key macroeconomic indicators, including GDP, employment and trade. Becker et al. (2018) document positive yet heterogeneous effects that are sensitive to the business cycle and the absorptive capacity of regions. Crescenzi and Giua (2020) demonstrate that cohesion policy does not operate as a uniform mechanism, as its impacts vary systematically across member states. Crucitti et al. (2024) quantify a macroeconomically significant positive effect of cohesion policy from 2014 to 2020 on regional growth, which is more pronounced in less developed regions. Casas et al. (2025) demonstrate that cohesion policy contributes positively to the achievement of sustainable development goals. Pinar and Karahasan (2024) caution that the effects of cohesion policy are asymmetric and weaken during periods of macroeconomic uncertainty.

Scotti et al. (2022) document that ESIF investments in energy, research and development, and transport generate both immediate and long-term growth effects, accompanied by spatial spillovers. Oleš and Hudcovský (2024) document, on a sample of European regions, a pronounced core-periphery pattern with divergent convergence speeds across regional groups. Stoilova (2025) illustrates, drawing on the case of Bulgaria, how macroeconomically established impacts manifest within a specific national context.

Research and technological development funding from the funds strengthens regional innovation systems and cultivates collaboration among firms, universities and research institutions (Rodríguez-Pose and Crescenzi, 2008). Ferrara et al. (2017) demonstrate that interventions targeting research, innovation and transport accessibility exert a positive influence on regional growth and productivity. However, positive effects are not automatic: the spatial concentration of public R&D funding in already well-endowed regions may reinforce existing innovation-led regional inequalities (Rodríguez-Pose, 2018; Fitjar, 2025).

The empirical literature consistently identifies institutional quality as a key moderator of the relationship between ESIF and growth. Crescenzi et al. (2016) demonstrate that the economic returns to transport infrastructure investment are conditioned by the quality of regional governance. D'Agostino and Scarlato (2016) provide complementary evidence that institutional quality and innovation are associated with economic growth in European countries. Fidrmuc et al. (2024) find a significantly positive effect of EU funds on regional economic growth and show that interregional spillovers are important, with part of the favourable effect materializing in neighbouring regions. Spilioti and Anastasiou (2024) emphasize that the effectiveness of ESIF varies according to governance quality, economic freedom and the administrative capacity of the institutions managing the funds.

2. Research Methodology

Our aim is to systematically map the research field, developmental trajectories and thematic configuration of European Structural and Investment Funds in relation to innovation performance and economic growth. Bibliometric analysis enables the quantitative and systematic processing of large volumes of scientific literature. The combination of performance analysis and science mapping provides a two-dimensional perspective on the field, identifying its key actors, including authors, journals, countries and institutions, while simultaneously revealing the thematic patterns and clusters that structure the research. These methods therefore represent an effective and well-founded approach (Donthu et al., 2021; Aria and Cuccurullo, 2017) for the study of cohesion policy, innovation activity and economic growth.

Five research questions were formulated in line with the stated objective.

RQ1: How has the volume of publications evolved over time and how does this evolution relate to the field's conceptualization of ESIF effectiveness? The existing literature suggests that research devoted to the evaluation of EU cohesion policy is relatively strongly responsive to institutional changes; Barca et al. (2012) identify the 2007 to 2013 programming period as a catalyst for academic interest. We therefore expect that growth in publication activity will follow a phased rather than linear trajectory, correlated with cohesion policy programming cycles.

RQ2: Who are the most relevant and influential authors, sources, institutions and countries? The asymmetry between publication volume and citation impact is documented through the Matthew effect (Larivière & Gingras, 2010), while Lotka's and Bradford's laws predict a concentration of production within a small core of authors and sources. We expect a small number of entities to account for a disproportionately large share of total output.

RQ3: What is the citation and collaborative structure of the field? We expect the field to exhibit multiple distinct citation clusters with limited cross-cluster connectivity.

RQ4: Which themes are established and which are emerging and why do evaluative findings on ESIF effectiveness remain heterogeneous across them? We expect emerging themes to resonate around sustainability and the green impacts of ESIF utilization, thereby reflecting the new priorities of cohesion policy and confirming the field's responsiveness to institutional impulses.

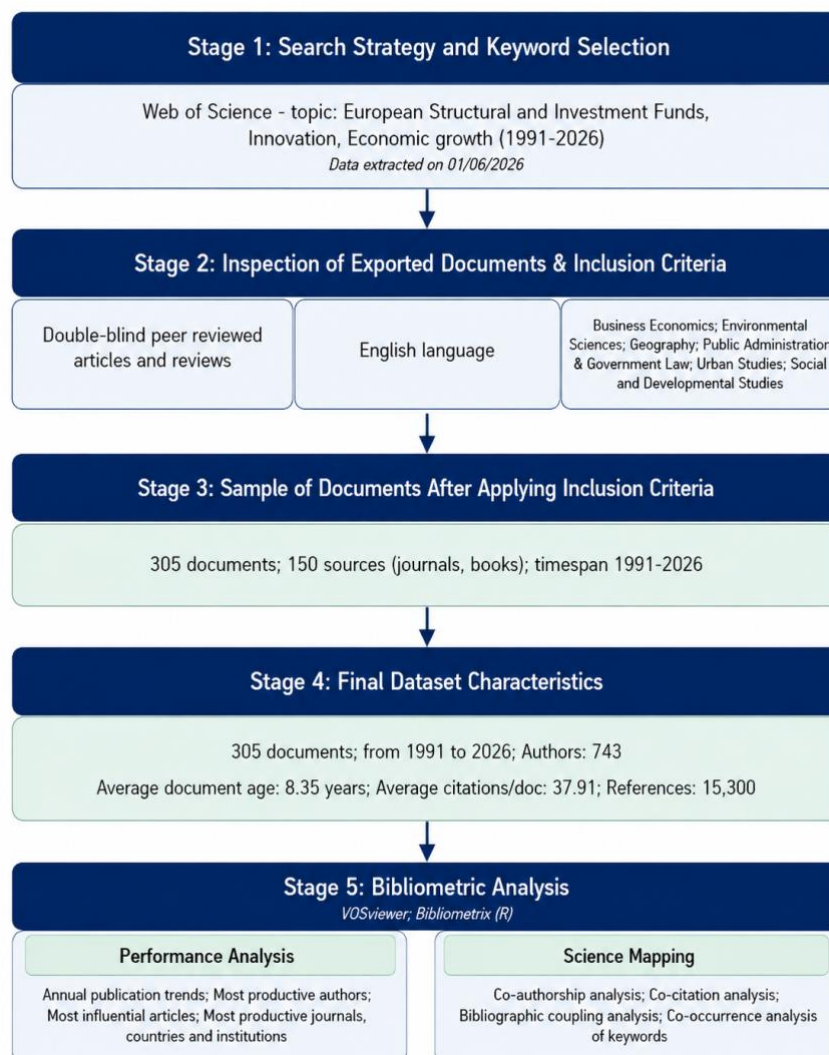
RQ5: What are the main thematic clusters and which research areas are the most relevant for future cohesion policy evaluation? We expect the field to lack a dominant motor theme and to be organized predominantly around parallel thematic streams with limited mutual integration.

The methodological procedure of the bibliometric analysis consists of five main steps, summarized in Figure 1: (1) search strategy and keyword selection, (2) inspection of exported documents and application of inclusion criteria, (3) sample of documents after applying inclusion criteria, (4) final dataset characteristics, and (5) bibliometric analysis.

The search was conducted using a combination of keywords with Boolean operators AND and OR. The keywords were organized into three thematic blocks: (i) ESIF and cohesion policy, including European Structural and Investment Funds, ESIF, EU structural funds, Cohesion Policy, ERDF and ESF; (ii) innovation, including innovation, technological change, research and development, R&D and knowledge spillovers; and (iii) economic growth, including economic growth, regional growth, productivity and total factor productivity. The exact search string applied in the Topic field (TS) of the Web of Science database, which covers titles, abstracts, author keywords and Keywords Plus, is presented below.

TS = ("European Structural and Investment Funds" OR ESIF OR "EU structural funds" OR "European structural funds" OR "Cohesion Policy" OR "cohesion funds" OR "Structural Funds" OR "regional policy" OR "European regional development fund" OR ERDF OR "European Social Fund" OR ESF)
 AND
 (innovation OR "technological change" OR "technical change" OR "research and development" OR R&D OR "R and D" OR "knowledge spillovers" OR "innovation capacity" OR "innovation performance")
 AND
 ("economic growth" OR "regional growth" OR productivity OR "economic development" OR "total factor productivity" OR TFP))

Figure 1. Methodological Framework for the Bibliometric Analysis



Source: authors' own elaborations.

Data cleaning and selection were performed directly within the Web of Science (WoS) interface prior to export. The initial keyword search retrieved 432 records, which were refined using WoS built-in filters (document type restricted to Article, language restricted to English, and subject categories limited to those specified below) reducing the sample to the final 305 documents. As all records originate from a single database and export, no duplicates were present.

The dataset was then imported to Bibliometrix/ Biblioshiny (Aria and Cuccurullo, 2017) for all subsequent analysis, ensuring a fully reproducible selection procedure. Focus only on peer-review academic literature in English language reflects the paper's aim of mapping the academic research field rather than the broader grey-literature evidence base and we follow standard practice in bibliometric mapping studies, where citation-based methods require uniformly indexed source material. In the second step, thematic relevance was verified through a review of titles and keywords.

The final sample comprises 305 documents published between 1991 and 2026, with data collected on 1 June 2026. The bibliometric analysis was conducted in R using the bibliometrix package and the Biblioshiny interface (Aria and Cuccurullo, 2017). Only documents from relevant Web of Science subject categories were included, specifically Business Economics, Environmental Sciences, Geography, Public Administration and Government Law, Urban Studies, and Social and Developmental Studies, thereby ensuring the thematic consistency of the corpus. The selection of these categories was motivated by the aim of covering the disciplinary pillars within which the relationship between ESIF, innovation and economic growth is systematically examined, namely the economic and business perspective (Business Economics), the spatial and regional dimension (Geography, Urban Studies), the institutional and policy framework (Public Administration and Government Law), and the broader socio-environmental contexts of sustainable development (Environmental Sciences, Social and Developmental Studies). These categories were selected deliberately to capture the disciplinary pillars through which ESIF, innovation and growth are studied, economic, spatial, institutional and socio-environmental, while excluding categories (e. g. pure engineering or agricultural science) whose primary focus lies outside the economic and policy dimension central to this study. Web of Science was selected as the sole data source rather than Scopus, as it offers standardized curated metadata (citations, etc.) required for co-citation and bibliographic-coupling analysis.

The bibliometric analysis rests on two complementary pillars. The first is performance analysis, encompassing the annual evolution of publications, the most relevant authors, the most influential articles, the most relevant journals, countries and institutions. The second pillar is science mapping, comprising co-authorship analysis, co-citation analysis, bibliographic coupling and co-word analysis. Within the performance analysis, standard metrics exported from Biblioshiny were employed, including the number of publications (TP), total citations (TC), average citations per document (AC), h-index, average number of co-authors per document and the share of international collaboration (MCP%). The strategic thematic map positions clusters within four quadrants according to Callon centrality (relevance degree) and Callon density (development degree), enabling the identification of motor themes and emerging themes. Data visualization was performed using Bibliometrix (RStudio). The following section presents the results of the analysis.

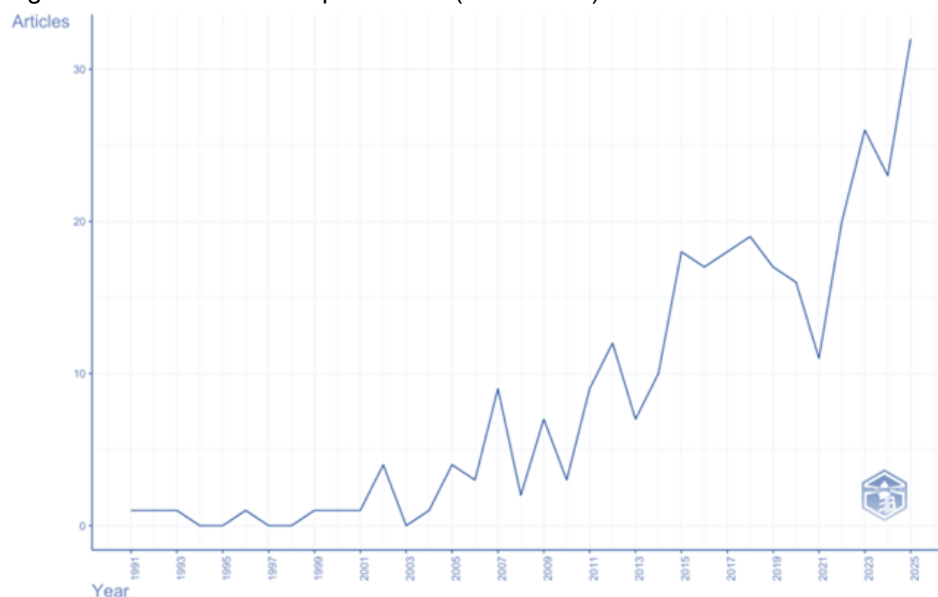
3. Results and Discussion

This section presents the findings of the bibliometric analysis, providing answers to the five research questions defined in the preceding section. All findings reported below describe patterns in the mapped literature and in the structure of the research field, they characterize how ESIF effectiveness has been studied, not whether ESIF are effective. The temporal evolution of publication activity, the profile of the most relevant and influential entities, the collaborative structure of the field, the intellectual foundations derived from co-citation analysis,

and the thematic architecture identified through bibliographic coupling and keyword analysis are described in turn. The analysed dataset comprises 305 documents indexed in the Web of Science Core Collection for the period 1991 to 2026. The documents were published across 150 sources and contain a total of 15,300 references. In terms of content, the dataset encompasses 575 Keywords Plus terms and 980 author keywords. A total of 743 authors contributed to the corpus, with 67 documents being single-authored. The average document age is 8.35 years, the average number of citations per document is 37.91, the average number of co-authors per document is 2.7, and the share of international co-authorship (MCP) stands at 22.62%. Articles dominate the dataset, accounting for 281 of the 305 documents, confirming the academic and peer-reviewed character of the corpus.

The annual evolution of publication activity (Figure 2) demonstrates that research on ESIF in relation to innovation performance and economic growth developed gradually, with growth following a non-linear trajectory. In the period 1991 to 2006, publication activity was low and sporadic, with a total of 19 documents representing an average of approximately 1.19 documents per year. A more pronounced increase is evident after 2007, when 94 documents were published during the period 2007 to 2016, corresponding to an average of 9.4 documents per year. A further acceleration occurred in the period 2017 to 2026, during which 192 documents were recorded, averaging 19.2 documents per year. The highest annual output was observed in 2025, with 32 documents. The overall annual growth rate of the dataset stands at 4.04%.

Figure 2: Annual Scientific production (1991-2026).



Source: Authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

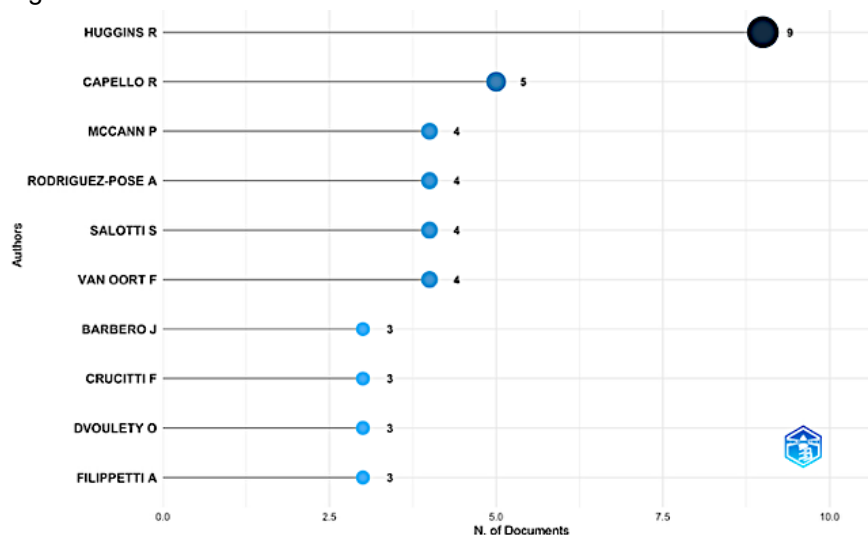
The annual citation trend must be interpreted with caution given the varying length of the citation window across publication years. The highest average number of citations per article was recorded for the year 2007, at 224 citations, while lower citation values in recent years should not be interpreted as a decline in the field's influence but rather as a consequence of the shorter period available for citation accumulation. Overall, the field has clearly progressed from sporadic publication activity to a steadily growing and established research agenda. Research on whether and how ESIF contribute to economic performance and innovation has

shifted over the past three decades from a peripheral concern to a field of sustained and growing scholarly interest. The acceleration observed after 2007 and 2017 coincides with successive cohesion policy programming periods suggesting that publication dynamics may be partly responsive to EU funding cycles. The most influential and widely cited works emerged during the period 2007 to 2013, suggesting that the field's core theoretical frameworks and methodological approaches have reached a degree of maturity. Nevertheless, the continued growth in the number of new studies indicates that no clear consensus has yet been reached on whether, how and under what conditions ESIF generate meaningful economic impact.

In terms of publication count (TP), as illustrated in Figure 3, the most relevant author is Huggins, with 9 documents, whose most cited publication in the dataset is Huggins and Williams (2011) with TC equal to 127. Huggins is followed by Capello with 5 documents, whose most cited work is Camagni and Capello (2015). A group of authors with 4 documents each comprises McCann and Rodríguez-Pose, who share the most cited publication in this group, namely Barca, McCann and Rodríguez-Pose (2012) with TC equal to 999, alongside Salotti, whose most cited work is Crucitti et al. (2023), and Van Oort, associated with Frenken et al. (2007) with TC equal to 1,742. From the perspective of citation impact, however, the ranking changes considerably. The highest total citation counts are achieved by Rodríguez-Pose with TC equal to 2,189, Van Oort with 1,823 citations and McCann with 1,690, while the most relevant author, Huggins, records a TC of 473. This divergence between publication volume and citation impact is examined further in Table 1.

Author productivity follows Lotka's law (Lotka, 1926): 687 authors (92.46%) published a single document, while only six authors produced more than three documents. The estimated exponent ($\beta = 3.17$ vs. the classical value of 2, $R^2 = 0.928$) indicates a more pronounced concentration among one-time contributors than the classical Lotka distribution would predict, consistent with the highly skewed productivity distribution, typical of a developing interdisciplinary field.

Figure 3: Most Relevant Authors



Source: authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

Table 1 compares the six most relevant authors and reveals three distinct profiles. The first is characterized by extreme citation concentration, where scholarly reputation rests almost exclusively on a small number of works, a pattern consistent with the Matthew effect. The

second is defined by high citation impact alongside a limited number of publications, reflecting the thematic precision and relevance of each contribution. The third comprises systematic cumulative contributors whose citation impact is distributed evenly across multiple works. The nearly 27-fold difference in the TC/TP ratio among authors with an equal number of publications empirically demonstrates that scientific contribution cannot be assessed based on a single bibliometric metric, nor does this analysis set out to do so. Nevertheless, this divergence indicates that the concentration of citation impact in a limited number of seminal publications allows a relatively small intellectual core to continue shaping the direction of the broader research discourse.

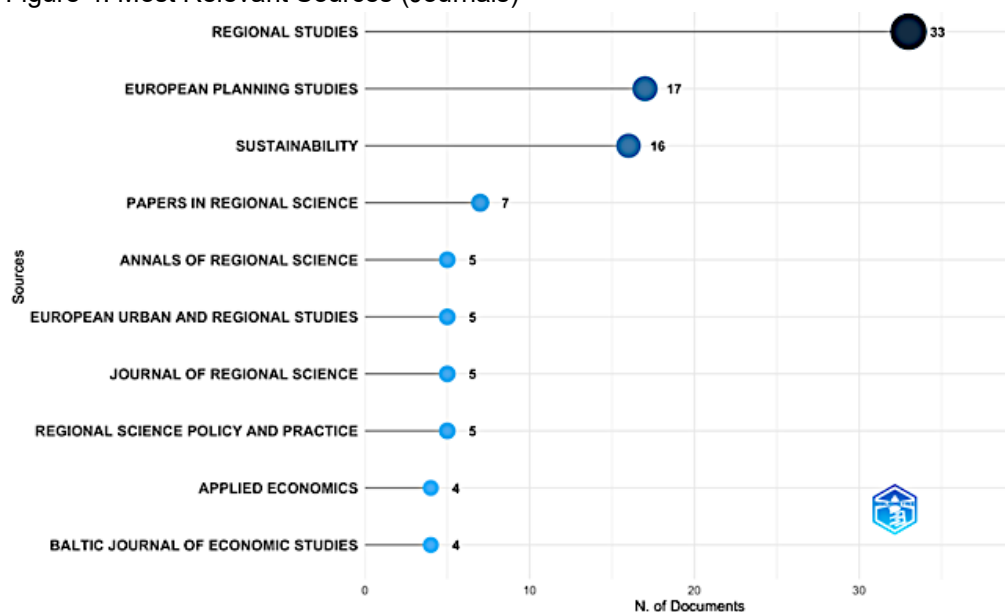
Table 1: Indicators of Citation Impact and Productivity of the Most Relevant Authors

Author	TP	TC	TC/TP	TC_max	% top paper
Huggins R.	9	473	52	127	26.9%
Capello R.	5	118	23	55	46.6%
McCann P.	4	1,690	422	999	59.1%
Rodríguez-Pose A.	4	1,184	296	999	84.4%
Salotti S.	4	68	17	24	35.3%
Van Oort F.	4	1,823	455	1,742	95.6%

Source: authors' own elaborations based on Web of Science data.

At the level of sources (Journals), as illustrated in Figure 4, the most relevant journal is *Regional Studies* with 33 articles, 4,419 citations and an h-index of 21, followed by *European Planning Studies* with 17 articles and TC equal to 384 and an h-index of 12, and *Sustainability* with 16 articles and an h-index of 8. The *Journal of Regional Science* published only 5 articles yet accumulated 1,113 citations, attesting to its selective but high-impact position within the field. The most relevant institution is Cardiff University with 13 articles, followed by the London School of Economics with 11 articles, and the Joint Research Centre and Utrecht University each contributing 10 articles.

Figure 4: Most Relevant Sources (Journals)



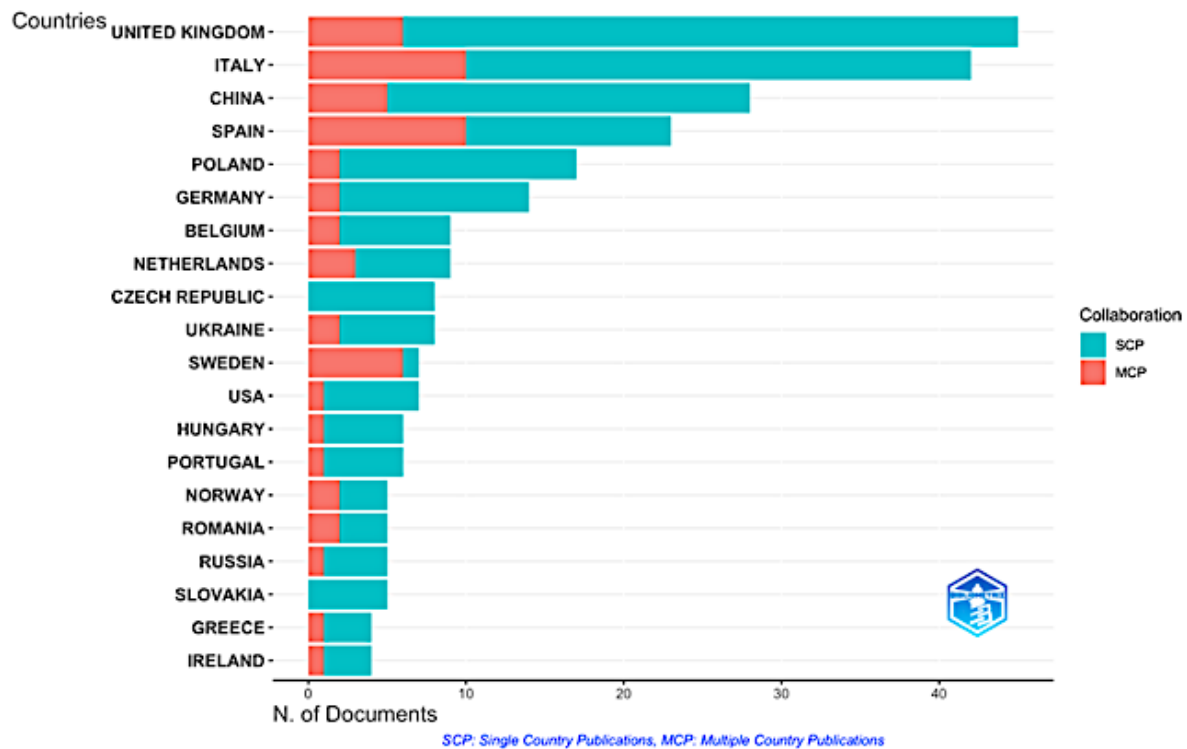
Source: Authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

Journals dispersion follows Bradford's Law of Scattering (Vickery, 1948) a core zone of just 11 journals (7% of 150 sources) concentrates roughly one third of total production, led by Regional Studies (33 documents) and European Planning Studies (17). This thematic orientation, regional studies, regional science, planning and economic geography, identifies the field's principal disciplinary base.

In terms of corresponding authors' countries, as illustrated in Figure 5, the leading positions are held by the United Kingdom with 45 articles representing approximately 15% of total production, Italy with 42 articles accounting for nearly 13%, China with 28 articles at 9%, and Spain with 23 articles at 8%. Poland occupies fifth place with 17 articles. Regarding international collaboration, the highest MCP shares are recorded by Sweden at 86% and Spain at 44%. In contrast, the Czech Republic and Slovakia exhibit a zero share of international co-authorship, indicating a nationally oriented research output.

The dominant position of the United Kingdom and Italy in terms of publication volume is plausibly associated with their long-standing traditions in regional and urban studies and with concentration of internationally established research institutions, including the London School of Economics, Cardiff University and Politecnico di Milano, which systematically engage with cohesion policy and regional development. This institutional concentration offers a likely explanation but was not independently tested in this analysis.

Figure 5: Corresponding Author's Countries

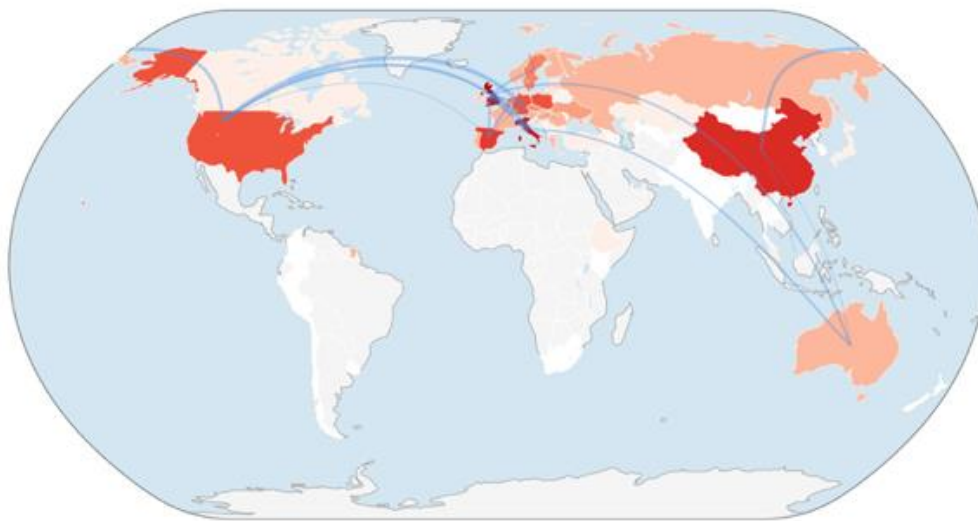


Source: Authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

The low share of international collaboration in the United Kingdom, at 13.3% MCP, stands in contrast to its publication dominance and is likely associated with the size of its national research community, which is sufficiently large to produce influential research without recourse to external collaboration, as well as with the gradual decline in the institutional integration of British universities into European research networks following Brexit. The most cited document in the corpus is Frenken et al. (2007) with 1,742 citations, followed by Barca

et al. (2012) with 999 citations, Rodríguez-Pose (2013) with 856, Irfan et al. (2022) with 665 and McCann and Ortega-Argilés (2015) with 644.

Figure 6: Co-authorship Network

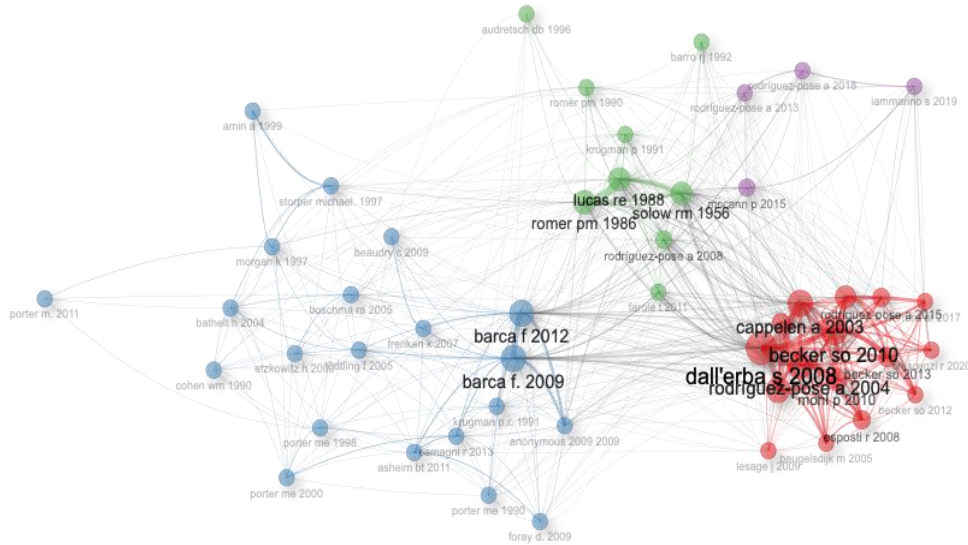


Source: authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

Within the science mapping framework (Figure 6), the collaborative structure was analysed through a co-authorship network. Of the 305 documents, 238 were published in co-authorship while 67 were single-authored. The visible co-authorship network comprises 36 nodes distributed across 13 clusters. Most of the clusters are small and weakly interconnected, suggesting a fragmented rather than highly integrated collaborative structure. The highest values of betweenness centrality are recorded by Barbero J. at 16, Rodríguez-Pose A. at 15 and McCann P. at 13. These authors function as bridges between otherwise disconnected research groups.

The intellectual foundations of the field were identified through co-citation analysis, as illustrated in Figure 7. The network of cited references comprises 50 nodes distributed across four clusters. Cluster 1, consisting of 16 references, focuses on the quantitative assessment of the effects of cohesion policy and regional interventions, encompassing works by Dall'Erba and Le Gallo (2008), Becker et al. (2010, 2013), Pellegrini et al. (2013), Cappelen et al. (2003), Ederveen (2006), Rodríguez-Pose and Fratesi (2004), Mohl and Hagen (2010), Crescenzi and Giua (2020) and Ferrara et al. (2017). Cluster 2, the largest with 21 references, is primarily oriented towards regional, policy and innovation research, including works by Barca (2009), Barca et al. (2012), Morgan (1997), Porter (1990, 2000), Porter and Porter (1998) and Asheim et al. (2011). Cluster 3, comprising 9 references, encompasses works by Romer (1986, 1990), Solow (1956), Lucas (1988), Krugman (1991), Barro and Sala-i-Martin (1992) and Audretsch and Feldman (1996), representing the theoretical and macroeconomic foundations of the field. Cluster 4, consisting of 4 references, forms the compact core of the contemporary institutional and policy research strand, comprising McCann and Ortega-Argilés (2015) and Rodríguez-Pose (2013, 2018).

Figure 7. Co-Citation Network of Cited References

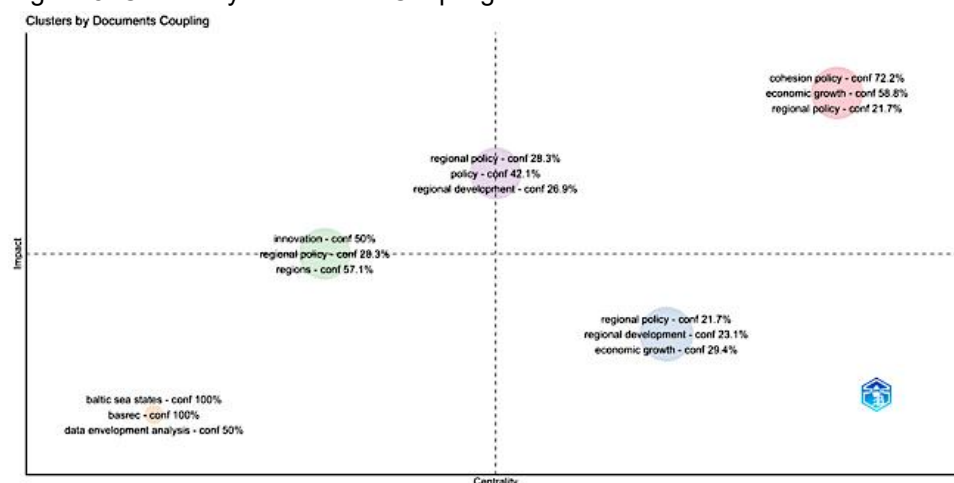


Source: Authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

In terms of network metrics, the highest betweenness centrality values are recorded by Romer (1986) at 117, Krugman (1991) at 120, Dall'Erba and Le Gallo (2008) at 55, Lucas (1988) at 65, Solow (1956) at 58 and Barca (2009) at 55. These works are frequently cited across multiple clusters, thereby bridging the theoretical, evaluative and regional-policy strands of research. Research on ESIF, innovation and economic growth draws on four distinct scholarly traditions: econometrics and policy evaluation (Cluster 1), regional and innovation economics (Cluster 2), macroeconomic growth theory (Cluster 3) and institutional-political analysis (Cluster 4). These four traditions reflect four different ways of conceptualizing ESIF. The evaluative-econometric tradition treats ESIF as a treatment with an estimable causal effect. The macroeconomic tradition treats ESIF as one channel within long-run growth theory. The regional-innovation tradition treats ESIF as an input into regional innovation systems. The institutional-political tradition treats ESIF as an instrument whose returns depend on governance quality. Each tradition therefore asks a different economic question about the same instrument. Their limited cross-citation reflects this conceptual divergence, not just disciplinary separation.

To capture the current thematic configuration of the field, bibliographic coupling analysis was conducted at the document level (Figure 8). The analysis identified five clusters, although one cluster contains only three documents. Cluster 1, comprising 61 documents with a centrality of 0.494 and an impact of 1.987, achieves the highest impact and the highest centrality value, representing the evaluative and quantitative core of the field focused on measuring the effects of cohesion policy and economic growth. Cluster 2, the largest with 73 documents, a centrality of 0.401 and an impact of 1.063, records the lowest impact and concentrates on the relationship between regional policy, regional development and economic growth. Cluster 3, comprising 56 documents with a centrality of 0.332 and an impact of 1.210, captures the regional-innovation strand of research and achieves the lowest centrality, indicating its relative thematic autonomy. Cluster 4, consisting of 57 documents with a centrality of 0.378 and an impact of 1.609, is oriented towards regional policy, smart specialization and place-based policies and records the second highest impact. Cluster 5 is marginal and thematically isolated, containing only three documents.

Figure 8: Cluster by Documents Coupling

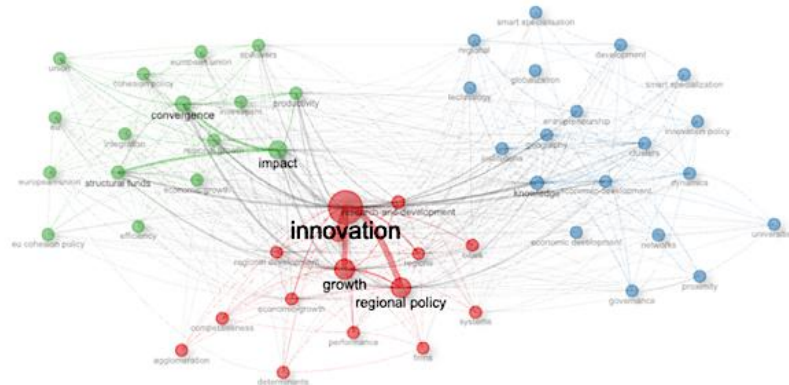


Source: authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

These findings suggest that the ESIF research field in relation to innovation performance and economic growth exhibits an internally differentiated yet thematically relatively coherent structure. The field's orientation is concentrated primarily around four lines of inquiry: the evaluation of cohesion policy and the measurement of its economic impact (Cluster 1), the analysis of regional growth and convergence (Cluster 2), the examination of regional innovation systems (Cluster 3) and smart specialization and place-based policies (Cluster 4). The dominance of Cluster 1 is consistent with the growing pressure from European institutions for evidence-based policy evaluation, which intensified during the 2007 to 2013 programming period. The thematic autonomy of Cluster 3, as evidenced by its lowest centrality value, suggests the existence of a gap between the regional-innovation literature and evaluative cohesion policy research, as these operate in largely separate citation circles despite sharing a common object of inquiry. Firm-level counterfactual impact evaluations demonstrate that causal identification and firm-level innovation indicators can be combined in practice, yet the core references identified within Clusters 1 and 2 are predominantly regional or macroeconomic in scope. Bridging this gap represents a concrete opportunity for future research linking evaluative-econometric methods with regional innovation system analysis.

The thematic architecture of the field, as illustrated in Figure 9, was analysed through a co-occurrence network of author keywords. The most frequent terms are innovation at 135 occurrences, growth at 70, regional policy at 68, impact at 57, policy at 52, convergence at 43, research-and-development at 39, knowledge at 37, structural funds at 36 and productivity at 36. The network comprises 50 nodes distributed across two clusters. Cluster 1, representing the innovation-policy stream, is concentrated around the terms innovation, regional policy, policy, knowledge, economic development, institutions, clusters, regions, entrepreneurship, smart specialization, performance and geography. Cluster 2, representing the growth-evaluation stream, encompasses the terms convergence, research-and-development, structural funds, productivity, economic growth, regional development, cohesion policy, investment, efficiency and European Union. Cluster 3, representing the knowledge-based regional development and smart specialisation stream. The highest values of betweenness centrality at 303.69 and PageRank at 0.102 are recorded by the term innovation, which appears in both clusters and functions as the primary bridge linking the innovation-policy and growth-evaluation themes across the entire network.

Figure 9: Keyword Co-occurrence Network

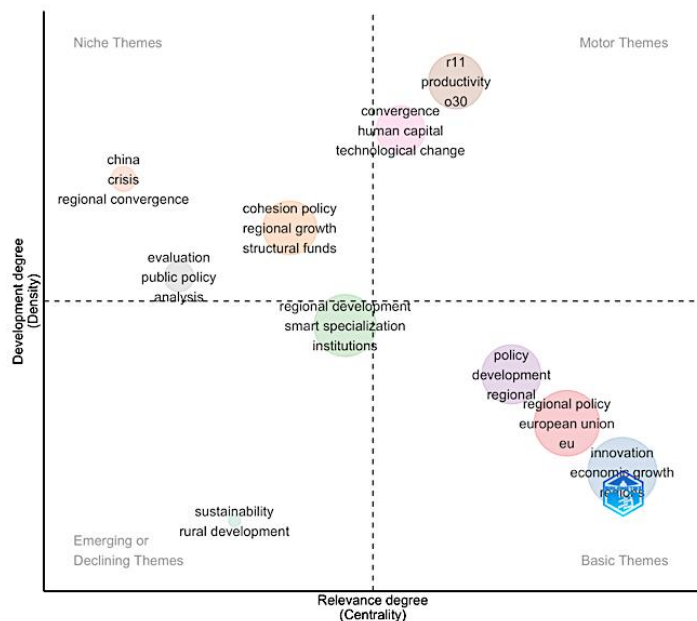


Source: authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

The analysis of trending topics reveals that among the more recently prominent terms, with median years of occurrence ranging from 2022 to 2025, are investment, sustainability, regional disparities, inequality and smart specialization, while older thematic layers, with median years ranging from 2010 to 2016, are more strongly associated with the term's strategy, R&D, firms, agglomeration and economic geography. This shift suggests a growing emphasis on questions of sustainability, spatial inequalities and the investment dimension of cohesion policy. A complementary perspective on the thematic structure of the field is provided by the strategic thematic map (Figure 10), which positions the identified clusters within two dimensions, namely centrality as the relevance degree and density as the development degree.

The strategic keyword map illustrated in Figure 10 confirms and structurally documents the thematic pluralism and fragmentation of the research field identified in the preceding analyses. Ten thematic clusters are observed, distributed across four quadrants according to centrality as the relevance degree and density as the development degree.

Figure 10: Strategic Thematic Map



Source: authors' own elaborations based on Web of Science data, visualized using Biblioshiny (Aria and Cuccurullo, 2017).

The field is organized around two parallel basic themes, namely the innovation and regional policy clusters, alongside a methodological strand represented by JEL code R11, yet lacks a dominant motor theme combining both high centrality and high density. This suggests that research on ESIF in relation to innovation performance and economic growth is thematically pluralistic and methodologically diversified.

The basic themes quadrant is dominated by the two largest clusters, innovation with a centrality of 3.111, density of 44.775 and frequency of 168, and regional policy with a centrality of 2.987, density of 45.464 and frequency of 139. Both clusters exhibit high centrality and low density, indicating that they constitute foundational, thematically open and cross-cutting categories. The motor themes quadrant is only sparsely occupied by a narrow methodological strand centered on productivity and spatial spillovers; although quantitative and econometric research constitutes the most developed research stream in the field, it does not reach the threshold of a dominant motor theme combining both high centrality and high density. The niche themes quadrant is dominated by cohesion policy with a centrality of 1.348, density of 64.539 and frequency of 75, and convergence with a centrality of 1.623, density of 69.195 and frequency of 57. The emerging or declining themes quadrant contains the sustainability cluster with a centrality of 0.617, density of 30.000 and frequency of 8. In the transitional zone, the regional development cluster with a centrality of 1.605, density of 51.111 and frequency of 115, and the policy cluster with a centrality of 2.371, density of 50.548 and frequency of 99 exhibit intermediate levels of both centrality and density, reflecting their integrative function in bridging distinct research streams. The fact that no cluster simultaneously achieves high centrality and high density, which constitutes the defining condition for a motor theme, empirically confirms the thematic pluralism of the field, in which research is distributed across parallel streams without a unifying dominant agenda.

Several implications follow from these findings. The field is fragmented across four separate citation circles and lacks a dominant motor theme. This fragmentation is consistent with the considerable breadth of the object of inquiry itself, though other contributing factors such as disciplinary boundaries between economics, geography and political science, or differences in methodological traditions, cannot be ruled out based on bibliometric evidence alone. Decision should therefore not rely on the findings of a single circle but synthesis across all circles and traditions is required. For the business sector, the closest stream is the regional-innovation tradition, yet this is also the most isolated one. Consolidated knowledge of how the funds affect firms is thus still lacking. The shift of research towards the themes of sustainability and digitalization signals where future investment priorities are heading. The evaluative-econometric tradition is the most developed and the most central, and the literature within this cluster provides the primary evidence base to which policymakers and managing authorities currently turn when assessing fund effectiveness. The macroeconomic tradition constitutes the shared theoretical foundation that bridges the individual research streams. The literature within the institutional-political tradition consistently reports that fund effectiveness cannot be meaningfully assessed without accounting for the quality of the institutional environment. Because no single tradition offers a complete account of ESIF effectiveness, conclusions drawn from any one citation circle in isolation should be regarded as a partial rather than conclusive evidence. This distinction is directly relevant to policymakers who commission single-tradition impact evaluations to inform funding decisions.

Publication activity mirrors cohesion policy programming cycles. Their evaluation should therefore be planned in good time and should provide robust evidence for the design of subsequent periods. This applies to the as-yet unevaluated green and digital priorities of the 2021–2027 period.

Conclusion

European Structural and Investment Funds represent the most extensive instrument of EU regional policy, with the primary objective of reducing economic and social disparities between regions, supporting innovation activity and stimulating economic growth. Despite having been in operation for more than three decades, no clear scientific consensus exists as to whether and how ESIF influence the innovation environment and economic growth. This research uncertainty reflects the complexity of the relationship between public investment funds, the institutional environment, innovation ecosystems and macroeconomic outcomes across the considerably heterogeneous European space.

The aim of this paper was to systematically map, through bibliometric analysis, the structure, developmental tendencies and thematic configuration of the research field devoted to the relationship between capital accumulation through ESIF, innovation activity and economic growth.

The methodology is based on a five-stage research design protocol, encompassing the search strategy and keyword selection in Web of Science, the handling of retrieved studies, the application of inclusion criteria and the construction of the final publication dataset. The analysis draws on a dataset of 305 documents by 743 authors, extracted from the WoS database for the period 1991 to 2026.

The analysis combines performance analysis and science mapping, with Bibliometrix within RStudio employed for the visualization of results.

Research on European Structural and Investment Funds, innovation activity and economic growth has recorded remarkable quantitative growth, advancing from an average pace of 1.19 documents per year during the period 1991 to 2006 to an overall annual growth rate of 4.04%, reflecting a dynamically expanding research agenda. This growth is, however, paradoxical. Despite the evident increase in the volume of empirical literature, no explicit convergence of findings has emerged. The field lacks a motor theme combining simultaneously high centrality and high density, which would be indicative of a consolidated research stream. Comparative analysis of the citation profiles of the most relevant authors confirms that scientific influence in this field is not the product of cumulative publication activity but is determined by the capacity to produce a single seminal work, as documented by the substantial divergence in TC/TP ratios and the pronounced citation concentration observed across multiple authors. More recent thematic shifts towards sustainability and green and digital transitions confirm the relevance of the 2021 to 2027 cohesion policy priorities, while simultaneously highlighting the need for systematic evaluation of their actual impacts, which remains absent from the current literature.

Overall, research has clearly progressed from sporadic publication activity to an active and steadily growing established research programme. Despite this establishment, a notable absence persists in the unified understanding of the conditions under which ESIF generate innovation-driven growth. A concurrent deficit is observed in research originating from Central and Eastern European countries, where ESIF are of existential importance, yet this geographical context remains considerably marginalized in the publication landscape. These

countries are simultaneously critical for the study of ESIF impacts, particularly in the context of their specific institutional environments. The empirical evaluation of the 2021 to 2027 programming period remains a relatively open question, especially regarding the new cohesion policy priorities associated with the green and digital transitions. Given that the mapped literature repeatedly reports institutional quality as a key moderator of fund effectiveness, future inquiry should focus on how specific governance mechanisms influence the innovation and growth returns of transfers across individual member states.

A further analytically noteworthy finding is that the structure of the research field appears to reflect not only the state of scientific knowledge but also the structure of cohesion policy itself. The fragmentation of research across four traditions, namely evaluative-econometric, regional-innovation, macroeconomic and institutional-political, is consistent with ESIF being an instrument that intersects multiple economic, institutional, innovation, political and other systems. The research field's fragmentation could be related to the considerable breadth of its object of inquiry resulting in the production of ever more detailed partial answers without cumulative synthesis. These findings carry direct implications for applied economic research. Because the evaluative econometric tradition is the field's most developed and central stream, it should remain the primary evidence base for policy relevant impact assessment, but its finding requires systematic synthesis with the institutional policy tradition, which indicates that fund effectiveness cannot be assessed independently of institutional quality, a synthesis best achieved through meta-analyses disaggregated by institutional capacity, development stage, intervention type and geographical context. The isolation of the regional innovation tradition points to a specific gap that applied research should prioritize, to deliver consolidated, econometrically grounded evidence on how ESIF affect firm-level innovation outcomes. Given that publication activity was found to coincide with cohesion policy programming cycles, evaluation frameworks should be designed *ex ante*, rather than assembled retrospectively once a period has closed. In view of the geographical asymmetry, where Central and Eastern European countries, despite considerable ESIF exposure, have a relatively limited presence in the analysed corpus, comparable, harmonized datasets covering Central and Eastern European regions should be developed to support future evaluative research. Because the sustainability cluster was identified as an emerging but not yet consolidated theme in the strategic thematic map, the evaluation of green and digital investments under the 2021-2027 programming period should be treated as a research priority.

A significant contribution of this paper lies in the recognition that bibliometric analysis does not answer the question of whether ESIF work but rather illuminates why this question remains pertinent and why it continues to resist a satisfactory answer.

The primary limitation of this paper is the restriction of data collection to a single database, namely Web of Science, which may systematically exclude a portion of relevant literature indexed in Scopus or Google Scholar as well as policy reports and institutional studies not covered by the selected WoS subject categories. This is because the WoS indexes predominantly peer-reviewed academic literature. The focus on English-language publications may have resulted in the omission of research published in national languages. These database and language restrictions carry consequences for the geographical findings. The geographical patterns reported above should therefore be interpreted as characteristic of the internationally visible, English-language, WoS indexed literature rather than of the full body of ESIF-related research.

Furthermore, bibliometric analysis can reveal the structure and dynamics of a field but not the causal mechanisms linking ESIF, innovation and growth, which remain the domain of primary empirical research. Notwithstanding these limitations, bibliometric analysis provides a systematic, replicable and data-driven overview of the state of the research field, a perspective that conventional narrative literature reviews are not equally positioned to offer.

CreDit Authorship Contribution Statement

Tankosova, T: Conceptualization, writing original draft, Data Curation, Methodology; Pekarcik, M: Conceptualization, Data Curation, Methodology; Buleca, J: Writing original draft (theoretical part), Review and Editing; Safar, L: Writing original draft (theoretical part), Review and Editing.

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Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

Data Availability Statement

The bibliometric records used in this study were retrieved from the Web of Science Core Collection, subject to institutional access. The cleaned dataset, search strategy and analysis code are available from the corresponding author upon reasonable request.

Ethical Approval Statement

This study is based on bibliometric and publicly available data obtained from the Web of Science database and other institutional sources. No human participants, personal data, survey, interviews, or experimental procedures were involved. Therefore, formal ethical approval was not required for this study.

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