



# Entrepreneurship within the European Union's Industrial Policy in Academic Debates

## *A Scientometric Study*

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### Abstract

This study addresses a critical gap in understanding the evolving scholarly discourse on entrepreneurship within the European Union's industrial policy framework. While prior researches have examined isolated aspects of innovation or regional development, few studies have systematically mapped the intellectual landscape, thematic priorities, and collaborative networks shaping this important field. This study employs a mixed-methods bibliometric approach, leveraging Scopus data (1990–2024) and tools, i.e., RStudio, VOSviewer, and Python, to analyze 2,150 publications from 937 journals and 4,943 authors. This work offers the novelty of an evaluation of both quantitative trends (e.g., productivity, citation patterns) and qualitative thematic evolution, investigating entrepreneurship within the EU industrial policy research. Key findings reveal an 11.88% annual growth in publications since 1990, signaling heightened academic engagement with sustainability transitions (e.g., circular economy, Industry 4.0), regional innovation strategies, and policy frameworks. Leading journals, e.g., *Entrepreneurship and Regional Development*, dominates the discourse, while influential works done by Ghisellini et al. (2016) and Nelson and Winter (1985). Collaborative networks highlight interdisciplinary and cross-border partnerships, particularly in addressing climate resilience and digital transformation. This study may contribute to a roadmap for policymakers to align support structures with emerging research priorities, e.g., green entrepreneurship and SME digitalization, while underscoring the need for inclusive frameworks to integrate non-Anglophone and regional scholarship.

### Keywords

bibliometrics, entrepreneurship policy, European Union, industrial policy, scientometrics

### 1 Introduction

Entrepreneurship is the foundation of economic development within the European Union (EU), as it drives growth, innovation, and contributes to regional development. It significantly mitigates unemployment, with 2.5 million new enterprises generating 3.3 million jobs in 2018 alone (Mercedes, 2021). These ventures, particularly in technology, innovation, and services,

not only address labor market gaps but also stimulate economic growth via the introduction of novel products and business models (Komninos et al., 2024). Entrepreneurship enhances productivity and competitiveness, strengthening the EU's strategic focus on sustained growth (Mercedes, 2021). The innovation-driven nature of entrepreneurship further supports the EU's global position, and such an ecosystem fosters adaptability, enabling small and medium-sized enterprises (SMEs) to adapt to the competitive markets while shaping flexible employment (Luna & Serrano, 2005). The EU has implemented various policies to support entrepreneurship, e.g., bureaucracy reduction, improving physical infrastructure, and providing access to financing (González-Morales et al., 2023; Komninos et al., 2024). Those are the keys to creating a constructive environment, as targeted policies are required to bridge regional gaps between the West-North versus the South-East, and foster inclusive entrepreneurial ecosystems (Bartekova & Janikovicova, 2025).

The EU's approach to establishing entrepreneurship policy has evolved considerably. In its early stages, prior to the late 1990s, efforts lacked dedicated frameworks for fostering entrepreneurial activity, relying instead on broad enterprise-promotion strategies that indirectly addressed the needs of SMEs and entrepreneurs, often incidentally (Arenal et al., 2021). Between the late 1990s and early 2010s, the focus transitioned toward analyzing the entrepreneurial landscape and implementing measures to boost SMEs, emphasizing systemic support (Arenal et al., 2021). From the 2010s onward, policy frameworks have grown, prioritizing not only the expansion of entrepreneurial ventures but also their strategic development in terms of innovation, scalability, and sustainability (Arenal et al., 2021). The same goes for the EU's industrial policy, which has undergone significant evolution. The launch of the Europe 2020 Strategy marked a flagship initiative prioritizing industrial competitiveness, SME expansion, and employment creation (Karlsson & Tavassoli, 2019). Designed to align with global economic integration and rapid technological progress, this framework promotes strategic state involvement in advancing innovation and sustainable growth (Benner, 2019; Fontana & Vannuccini, 2024). Central to this approach are programs, e.g., Horizon 2020 and smart specialization, which emphasize innovative public-sector-driven initiatives and strategic policy measures (Benner, 2019).

### **1.1 Industrial policy and entrepreneurship in the EU**

The EU's industrial and entrepreneurship policies, while different in focus, reflect complementary yet different strategic priorities. Industrial policy centers on strengthening the competitive advantage and long-term feasibility of the manufacturing sector, addressing systemic challenges, e.g., technological disruption, globalization, and competition from emerging economies (Nemcová, 2006; Zourek, 2007). Industrial policy employs a dual approach of sector-specific interventions, i.e., targeting industries like automotive or renewable energy, and horizontal measures that cut across technology, environmental sustainability, and workforce development (Farla et al., 2015). Strategies include enhancing cost competitiveness through internal reduction, scaling innovation via frameworks like Horizon 2020, and reversing deindustrialization trends by elevating manufacturing's contribution to GDP (Benner, 2019; Wigger, 2018).

In contrast, entrepreneurship policy prioritizes the development of a dynamic ecosystem for business creation and innovation, with a focus on reducing bureaucratic administration and fiscal barriers to enterprise growth (Buracas et al., 2012; Dvouletý et al., 2020). While also leveraging multilevel governance, its strategies emphasize enabling conditions for SMEs and high-impact ventures, e.g., access to financing, skill development, and market-oriented innovation (Bate, 2021; Ignatov, 2018; Krakowiak-Bal et al., 2017). Such evolutionary shifts from a generic SME support

to targeted initiatives promoting high-growth entrepreneurship reflect efforts to drive sustainable economic development (Crudu, 2019; Gajewski, 2017). Strategy Europe 2020 underscores its role in sustainable development, linking entrepreneurial features to regional economic strategies (Varga et al., 2020). Table 1 explains aspects of the EU’s industrial and entrepreneurship policy.

**Table 1. Aspects of the EU’s Industrial and Entrepreneurship Policies**

Aspect	Industrial Policy	Entrepreneurship Policy
Key Frameworks	Europe 2020 Strategy, Horizon 2020, smart specialization	Tailored instruments for each country’s economic structure
Focus Areas	SME growth, innovation, technology, skills, productivity	Promotion of entrepreneurship, addressing financial barriers
Coordination	Integrated approach combining various policy dimensions	Intersectoral coordination, particularly in education and employment
Challenges	Technological change, global trade, emerging market competitors	Varying effectiveness depending on environmental conditions
Opportunities	Innovation-driven economy, structural change, productivity revolution	Eco-innovation, local development in rural areas

Source: Author’s edit based on: Benner (2019); Bosworth et al. (2011); Ghisetti et al. (2017); Karlsson & Tavassoli (2019); Larosse (2012); Zourek (2007).

**1.2 Problem statement and main research question**

Current scholarship on the EU’s industrial and entrepreneurship policies largely examines them as distinct domains, with industrial policy focusing on sectoral competitiveness and structural economic shifts, and entrepreneurship policy emphasizing ecosystem-building and SME facilitation. A critical gap lies in exploring entrepreneurship issues within the EU’s industrial policy. Those, as previously explained, tend to analyze these policies as disconnected frameworks, overlooking synergies such as SME-driven innovation within industrial sectors, or the influence of entrepreneurial innovation on reducing deindustrialization trends.

As entrepreneurship intersects with industrial policy, this raises an important question, namely: *How have the EU’s industrial policy frameworks, as discussed in academic literature, addressed entrepreneurship issues?* Bibliometric analysis, or scientometric study, a method mapping thematic development and citation networks, could explore such underexplored connections, addressing this important question.

**2 Scientometric frameworks**

The theoretical foundation of this scientometric study draws on probabilistic models of cumulative gain, which analyze systems overseen by stochastic procedures (randomness modelling systems) (Firmansyah et al., 2022; Priandani et al., 2025). These frameworks rely on skewed or hyperbolic distributions to statistically represent phenomena where prior achievements increase chances of future success (Hassan et al., 2022; Hudaefi, 2025). In academic contexts, for instance, highly cited works gain unequal visibility, prolonging their influence (Price, 1976), while productive researchers maintain higher publication rates compared to less-established

peers (Price, 1976). Such dynamics underpin Lotka's law (Pao, 1985), which models author productivity, and Bradford's law (Alabi, 1979), which examines journal distribution patterns.

To investigate entrepreneurship issues within the EU's industrial policy in academic works, this study employs scientometric approaches, specifically, intellectual landscape mapping and productivity evaluations, using data from the Scopus database. Intellectual mapping integrates methods such as citation or co-citation analysis, bibliographic coupling, collaboration networks, and conceptual co-occurrence to uncover thematic trends and institutional collaborations (Aria & Cuccurullo, 2015; Donthu et al., 2021).

## 2.1 Productivity evaluation

Bibliometric productivity analysis assesses scholarly contributions through metrics, e.g., publication counts, citation frequencies, and impact ratios. It identifies emerging trends, evaluates the influence of authors, institutions, journals, and countries, and maps thematic evolution across individual and collective levels (Donthu et al., 2021; Hudaefi, 2025). In this study, productivity analysis addresses the first research question (RQ1):

- *How have academic publications, author networks, and citation patterns evolved in addressing entrepreneurship-related issues within the EU's industrial policy?*

## 2.2 Citation networks and intellectual development

Citation analysis serves as an intellectual impact assessment tool, mapping citation flows to identify seminal works, journals, or researchers (Supriani et al., 2022). Co-citation analysis infers thematic proximity between frequently co-cited publications, revealing interdisciplinary clusters (Ma'ruf et al., 2024). Together, these methods trace the intellectual architecture of a field. For this study, they grounded the second research question (RQ2):

- *Which articles, authors, countries, and affiliations have made the most significant scholarly contributions to analyzing entrepreneurship-related issues within the EU's industrial policy?*

## 2.3 Conceptual and thematic linkages

Co-word analysis decodes evolving conceptual frameworks by examining term co-occurrence in academic texts (Aria & Cuccurullo, 2015), while bibliographic coupling groups publications sharing similar references, enabling the identification of thematic and collaborative clusters (Kessler, 1963). These techniques collectively ground the third research question (RQ3):

- *How do scholarly works addressing entrepreneurship issues within the EU industrial policy connect through shared theoretical frameworks, cited literature, and conceptual similarities?*

## 2.4 Collaborative network analysis

Network analysis evaluates authorship connections (Apriantoro & Septianozakia, 2024), focusing on micro-networks of high-impact contributors to map cross-institutional and cross-border partnerships (Donthu et al., 2021). It visualizes knowledge dissemination pathways and institutional associations. In this study, it addresses the fourth research question (RQ4):

- *How do collaborative networks among authors, academic institutions, and countries shape the entrepreneurship issues within the EU industrial policy?*

### 3 Data and tools

Data was collected via a systematic approach from the Scopus database, generating bibliographic data on entrepreneurship within the EU's industrial policy. The initial search was restricted to the 28 EU member states (the UK being included) to ensure geographic relevance. A keyword-based query in Scopus' database (article titles, abstracts, and keywords) using 'industrial policy' was first done, resulting in the initial 21,075 documents. Further search refinement was done within this initial result, in which the keywords 'entrepreneurship policy' were used, yielding the final dataset of 2,150 documents. This final corpus was used for analyzing conceptual and empirical works on entrepreneurship within the EU's industrial policy.

The bibliometric analysis in this study used primarily RStudio. It is a machine learning tool that requires proficiency in language programming, statistical computing, and graphical analysis. This study utilized the bibliometric packages, i.e., bibliometrix and biblioshiny, developed by Aria and Cuccurullo (2017). Furthermore, VOSviewer, developed by Van Eck and Waltman (2010), was utilized to generate graphical networks for various bibliometric analyses, e.g., co-occurrence, co-citations, and co-authorship analyses. In addition, Phyton was also used to reproduce the visualization of some part of the analysis.

#### 3.1 Overview of the dataset

As detailed in *Table 2*, the dataset comprises 2,150 peer-reviewed publications sourced from the Scopus database, spanning from 1990 to 2024. This dataset highlights influential studies on entrepreneurship issues within the EU's industrial policy, showing a publication growth rate of 11.88% annually and an interdisciplinary scope disseminated across 937 different publication platforms. The majority of documents are journal articles (n=1,560), complemented by edited book chapters (n=202), conference proceedings (n=114), review papers (n=93), books (n=71), and others. The collaboration of this research domain is evident through the involvement of 4,648 scholars, with an average of 2.75 co-authors per paper and 37.85% of publications reflecting international research partnerships. Thematic diversity is captured through 5,197 author-assigned keywords and 4,348 algorithmically extracted keywords plus terms.

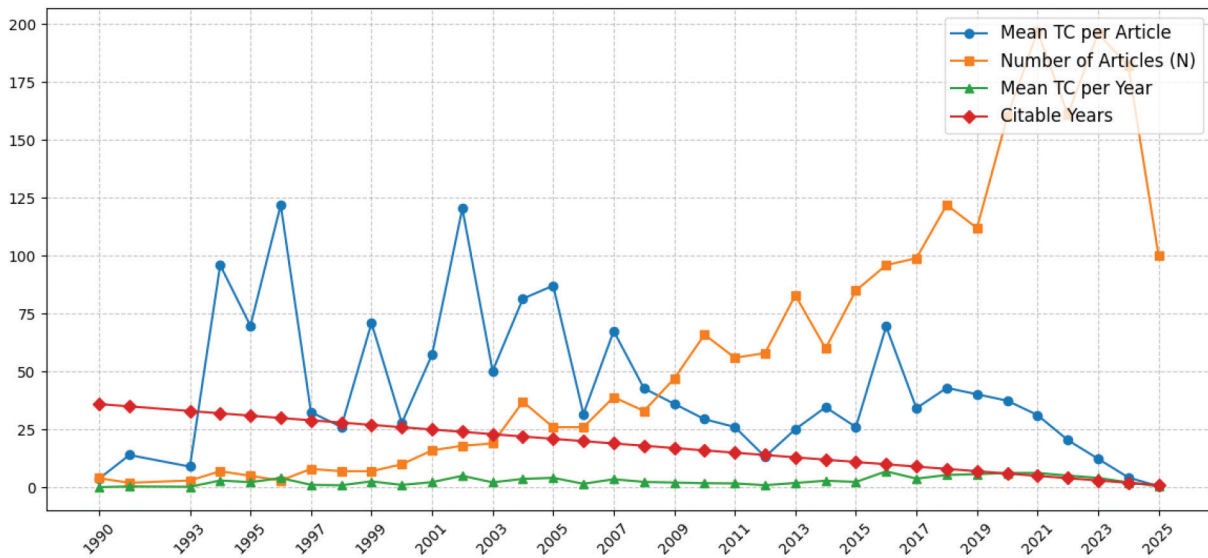
*Figure 1* shows trends in academic citations from 1990 to 2024. Early years (1990–1994) show low mean citations per article ( $\leq 14$ ) and declining citable years (36–32). A sharp increase occurs in 1995, with mean citations rising to 69.8 and stabilizing until 2000. Subsequent fluctuations follow, peaking at 120.44 in 2002 before declining. Notably, citable years steadily decrease from 36 to 1, reflecting reduced long-term citation relevance. Post-2010, the number of publication surges, reaching 100 in 2025, while mean citations per year fall below 1 after 2022. In addition, *Figure 2* visualizes the relationships between authors (AU), journals (SO), and their keywords (KW\_Merged) from the dataset. The flow from left to right shows which authors publish in which journals and the keywords associated with their publications. M. R. Di Tommaso, F. Spigarelli, and E. Barbieri appear to be highly productive, with many papers published across multiple journals. The most popular journals seem to be *Industry and Innovation* and *Technovation*, which align strongly with keywords, e.g., 'industrial policy', 'innovation', and 'industrial development'.

**Table 2. Descriptive statistics of the dataset**

<i>Main Information About Data</i>	
Timespan	1990:2024
Sources (Journals, Books, etc.)	937
Documents	2050
Annual Growth Rate %	11.88
Document Average Age	8.53
Average citations per doc	32.96
References	135561
<i>Document Contents</i>	
Keywords Plus (ID)	4348
Author's Keywords (DE)	5197
<i>Authors</i>	
Authors	4648
Authors of single-authored docs	383
<i>Authors Collaboration</i>	
Single-authored docs	418
Co-Authors per Doc	2.75
International co-authorships %	37.85
<i>Document Types</i>	
Article	1560
Book	71
Book chapter	202
Conference paper	114
Editorial	6
Note	2
Retracted	1
Review	93
Short survey	1

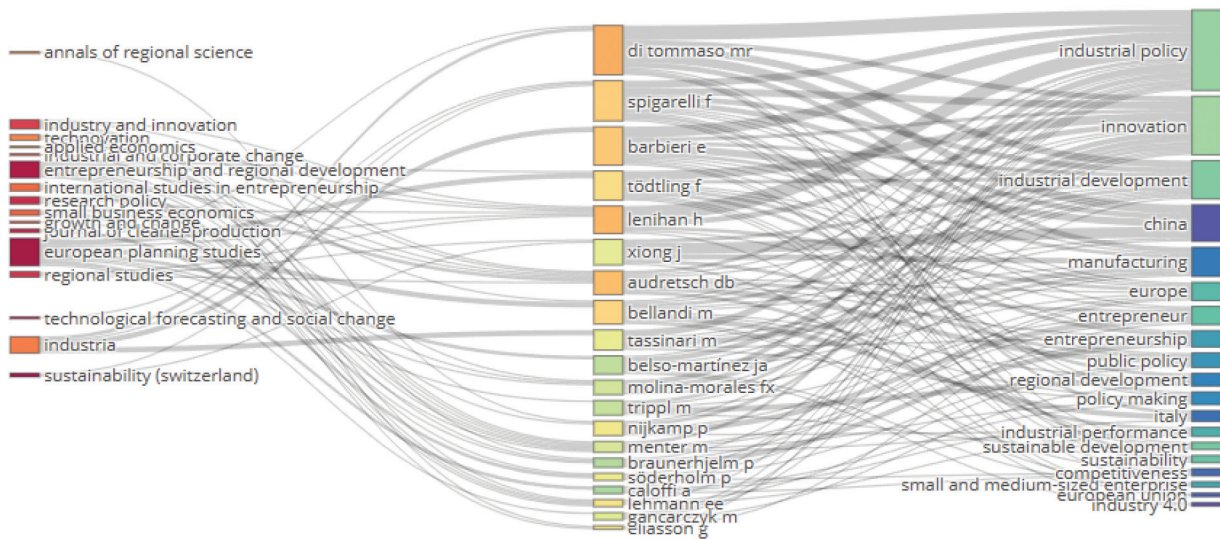
Source: Author's analysis via Biblioshiny.

**Figure 1. Publication and citation trends**



Source: Author’s analysis via Biblioshiny, reproduced via Phytton

**Figure 2. Sankey flows of impactful authors, significant keywords, and academic sources**



Source: Author’s analysis via Biblioshiny. Middle plot: Authors. Right plot: Keywords. Left plot: Academic sources.

## 4 Results and analyses

### 4.1 Impactful academic sources

Impactful academic sources (e.g., journals, books, conference proceedings, among others) are measured based on quantitative citation metrics, e.g., h-index, g-index, m-index, total citations (TC), and number of publications (NP). Of the 937 academic sources in the dataset, *Entrepreneurship and Regional Development* emerges as the most influential with the highest

h-index (30), g-index (50), among all entries. In terms of NPs, *European Planning Studies* is one of the most influential works with 90 NPs, while *Journal of Cleaner Production* was the highest in terms of TCs (7,811). *Technological Forecasting and Social Change* follows with a g-index of 47 and 3,204 total citations. *Table 3* details the top 10 academic sources, measured by academic index metrics, total citations (TCs), and number of publications (NPs).

**Table 3. Top 10 academic sources**

Impact based on index metrics					Impact based on TC		Impact based on NP		
h_index		g_index		m_index		Total Citations (TC)	Number of publications (NP)		
Entrepreneurship and Regional Development	30	Entrepreneurship and Regional Development	50	Sustainability (Switzerland)	2.4	Journal of Cleaner Production	7811	Sustainability (Switzerland)	90
European Planning Studies	27	European Planning Studies	47	Energies	1.5	Research Policy	4947	European Planning Studies	74
Research Policy	27	Technological Forecasting and Social Change	47	IEEE Transactions on Engineering Management	1.5	Technological Forecasting and Social Change	3204	Entrepreneurship and Regional Development	51
Journal of Cleaner Production	26	Sustainability (Switzerland)	45	Technological Forecasting and Social Change	1.1	Entrepreneurship and Regional Development	2565	Technological Forecasting and Social Change	47
Sustainability (Switzerland)	26	Journal of Cleaner Production	38	Journal of Cleaner Production	1	European Planning Studies	2415	Journal of Cleaner Production	38
Technological Forecasting and Social Change	24	Research Policy	35	Heliyon	1	Sustainability (Switzerland)	2300	Research Policy	35
Industry and Innovation	18	Regional Studies	32	Environmental Science and Pollution Research	1	International Journal of Information Management	2274	Regional Studies	32
Business Strategy and The Environment	15	Industry and Innovation	30	Journal of Environmental Management	1	Long Range Planning	1875	Industry and Innovation	31
Regional Studies	15	Business Strategy and The Environment	26	Sustainability (Switzerland)	1	Industrial and Corporate Change	1620	Business Strategy and The Environment	26
Industrial and Corporate Change	14	Industrial and Corporate Change	20	Biomass and Bioenergy	1	Regional Studies	1570	Energies	22

Source: Author’s analysis via Biblioshiny.

#### 4.2 Impactful manuscripts

The top 10 papers are evaluated based on global citations (GC) (overall citation in Scopus), local citations (LC) (citation in the dataset), and most-referred works. Of the 2,150 manuscripts in the dataset, *A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems* (Ghisellini et al., 2016) is the most influential

in the dataset, measured based on its 23 LCs and 4,192 GCs. Closely following in TC is *Territorial Dynamic, Innovative Milieus and Regional Policy* (Maillat, 1995) with 17 LCs, and in GC is *Artificial Intelligence (AI): Multidisciplinary Perspectives on Emerging Challenges, Opportunities, and Agenda for Research, Practice and Policy* (Dwivedi et al., 2021) with 2,257 GCs. In addition, *Digital Affordances, Spatial Affordances, and the Genesis of Entrepreneurial Ecosystems* (Autio et al., 2018) has 1,756 GCs and 15 LCs. Furthermore, in terms of the most cited references, of the 143,816 references in the dataset, *The Competitive Advantage of Nations* (Porter, 1990), *Principles of Economics* (Marshall, 2013), and *An Evolutionary Theory of Economic Change* (Nelson & Winter, 1985), are the most cited references with the total citations (TCs) 132, 106 and 68, respectively. Table 4 details the top 10 of the manuscripts in the dataset.

**Table 4. Top 10 manuscripts**

Total Local Citations (LCs)		Total Global Citations (GCs)		Most Cited References	
Title	LC	Title	GC	Title	TC
A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems	23	A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems	4192	The competitive advantage of nations	132
Territorial dynamic, innovative milieus and regional policy	17	Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy	2257	Principles of Economics	106
Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems	15	Building dynamic capabilities for digital transformation	1756	An evolutionary theory of economic change	68
Entrepreneurship and the process of firms' entry, survival and growth	12	Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems	1063	Geography and Trade	49
Rebirth of Industrial Policy and an Agenda for the Twenty-First Century	11	Circular economy as an essentially contested concept	1036	The economy of cities	42
Industrial Policy: A Dying Breed or A Re-emerging Phoenix	10	Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities	738	Institutions, institutional change and economic performance	38
Start-up activities, individual characteristics, and the regional milieu: Lessons for entrepreneurship support policies from German micro data	10	Escaping carbon lock-in	733	Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation	31
The promotion of innovation in regional policy: Proposals for a regional innovation strategy	10	Entrepreneurship Capital and Economic Performance	604	Proximity and innovation: a critical assessment	29
Place-based innovation policy for industrial diversification in regions	9	Circular business models: A review	563	Firm resources and sustained competitive advantage	28
Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities	9	Smart factory performance and Industry 4.0	535	Absorptive capacity: A new perspective on learning and innovation	26

Source: Author's analysis via Biblioshiny.

### 4.3 Impactful authorship

*Table 5* highlights key contributors to the debates on entrepreneurship issues within the EU's industrial policy discussed in academic works. Of the 4,943 individual researchers, M. R. Di Tommaso emerges as the most influential author, evidenced by an h-index of 10, g-index of 15, and a cumulative total citation (TC) count of 4,192. This is closely followed by D. B. Audretsch (h-index: 9; TC: 2,265), and E. Barbieri (h-index: 9; TC: 2,257). Notably, H. Lenihan (h-index: 8; TC: 2,257) and P. Söderholm (h-index: 8; TC: 2,257) are also among the prominent scholars, reflecting their contributions to entrepreneurship issues within the EU's industrial policy. Meanwhile, the m-index values further highlight scholars like O. Lyulyov (m-index: 1.25) and T. Pimonenko (m-index: 1.0). Institutional contributions are led by Lund University (34 publications), followed by Utrecht University (30 publications) and the University of Florence (28 publications). Other notable contributors include Linköping University (25 publications), Luleå University of Technology (25 publications), and Politecnico di Milano (23 publications), all of which emphasize entrepreneurship issues within regional and industrial policy themes.

As depicted in *Figure 3*, geographically, Italy emerges as the leading contributor, with 250 publications, dominated by single-country publications (SCP) (teal), which may indicate a strong domestic research ecosystem. Spain (178) and Germany (132) follow, both exhibiting higher SCP than multiple-country publications (MCP) (red), suggesting localized scholarly activity. Sweden (120) and the Netherlands (91) also mark SCP dominance. Notably, China (62) and Poland (65) display modest MCP contributions, which may be reflective of emerging transnational collaborations. Others, e.g., Greece (35) and Hungary (20), contribute minimally, with small MCP engagement. Furthermore, depicted in *Figure 4*, the network visualized the 103 most impactful authors measured by co-citation frequency. Central to the network is the green cluster, dominated by M. R. Di Tommaso and F. Spigarelli, whose works form a hub in circular economy frameworks and regional innovation systems. This cluster is further supported by P. Söderholm, M. Landabaso, and J. Moodsson (pink cluster), whose cross-linkages emphasize environmental policy, industrial transformation, and entrepreneurship. A second prominent cluster is around J. Korhonen and C. Nuur (orange), emphasizing digital transformation and sustainable operations. Meanwhile, the blue cluster, with significant authors such as M. Trippel and F. Tödtling, focuses on innovation diffusion and policy design, with notable contributions from T. Hansen, reflecting a policy-oriented research agenda.

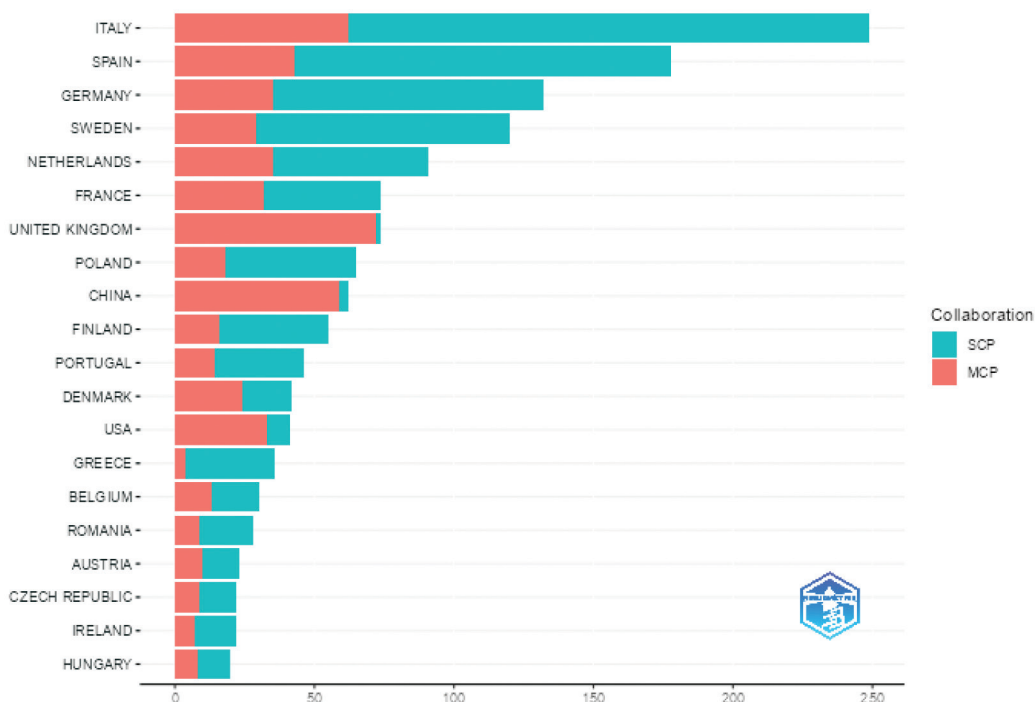
In addition, visualized in *Figure 5*, the historiography of impactful reveals important authorship. Foundational contributions include Johannisson et al. (1994), whose exploration of three phenomena, i.e., industrial districts, science parks, and corporate entrepreneurship in 1980s, shaped entrepreneurship via contextual networks, and Landabaso (1997), who examined the importance of regional innovation strategies to bridge the EU's technology gaps through enhanced public-private collaboration and targeted research and development investments in underdeveloped regions. Bellandi (2001) and Bellandi and Di Tommaso (2005) proposed a framework linking large firms and local economies through balanced social capital and policies, illustrated by China's specialized towns as "new industry" models, where state-driven industrial architecture challenges European competitiveness and informs strategies for regions like Italy's industrial districts. Audretsch (2004) and Wagner and Sternberg (2004) emphasized contextual networks influencing entrepreneurship, while Santarelli and Vivarelli (2007) critiqued entrepreneurial economic forecasting, underscoring cognitive biases in policy design. Aiginger and Rodrik (2020) and Nightingale and Coad (2014) later addressed state-led intrapreneurship and determinants of entrepreneurial success, respectively.

**Table 5. Top 10 authorships**

Impact Measures						Total Citations (TC)		Number of Publications (NP)		Top Affiliation		Top Country Affiliations	
Author	h-index	Author	g-index	Author	m-index	Author	TC	Author	NP	Affiliation	NP	Country	NP
Di Tommaso, M.R.	10	Di Tommaso, M.R.	15	Lyulyov, O.	1.25	Cialani, C.	4192	Di Tommaso, M.R.	15	Lund University	34	Italy	249
Audretsch, D.B.	9	Audretsch, D.B.	13	Pimonenko, T.	1	Ghisellini, P.	4192	Lenihan, H.	14	Utrecht University	30	Spain	178
Barbieri, E.	9	Lenihan, H.	12	Yan, S.	1	Ulgiati, S.	4192	Audretsch, D.B.	13	University of Florence	28	Germany	132
Lenihan, H.	8	Barbieri, E.	11	Ribeiro-Navarrete, S.	1	Jones, P.	2265	Spigarelli, F.	11	Linköping University	25	Sweden	120
Söderholm, P.	8	Spigarelli, F.	11	Žuk, P.	1	Aarts, G.	2257	Barbieri, E.	11	Luleå University of Technology	25	Netherlands	91
Spigarelli, F.	7	Bellandi, M.	10	Agostino, M.	1	Coombs, C.	2257	Bellandi, M.	10	University of Ferrara	25	France	74
Tassinari, M.	7	Tödtling, F.	9	Alaja, A.	1	Crick, T.	2257	Tödtling, F.	9	University of Helsinki	24	United Kingdom	74
Trippl, M.	7	Söderholm, P.	8	Alexandre, F.	1	Duan, Y.	2257	Söderholm, P.	8	Politecnico Di Milano	23	Poland	65
Bellandi, M.	6	Tassinari, M.	8	Aydin, M.	1	Dwivedi, R.	2257	Lehmann, E.E.	8	Umeå University	22	China	62
Grilli, L.	6	Eliasson, G.	8	Babadjanov, J.	1	Dwivedi, Y.K.	2257	Tassinari, M.	8	University of Macerata	22	Finland	55

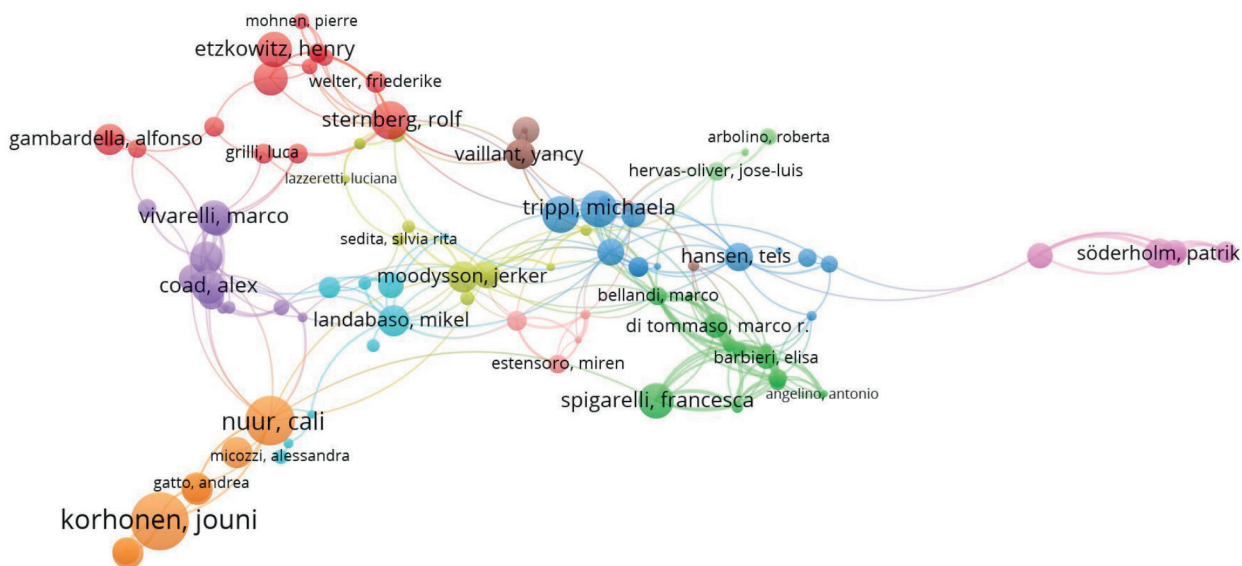
Source: Author’s analysis via Biblioshiny.

**Figure 3. Corresponding authors' countries**

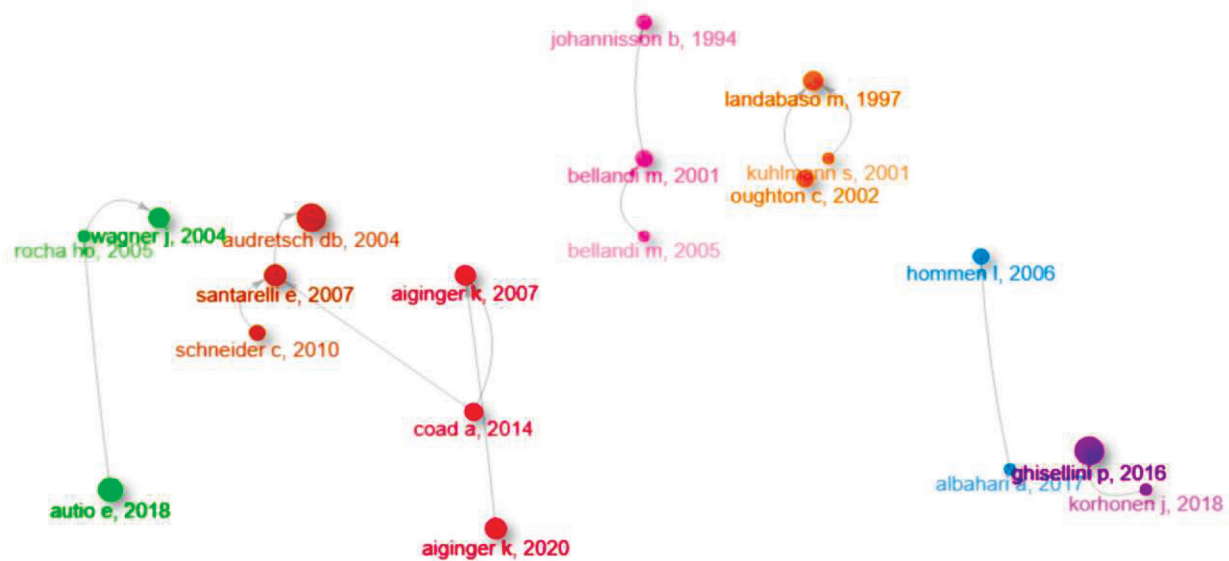


Source: Author’s analysis via Biblioshiny. SCP: Single Country Publications. MCP: Multiple Country Publications.

**Figure 4. Authors' citations network**



Source: Author’s analysis via VOSviewer. Data: 103 most impactful authors based on co-citations. Analysis used association strength with visualization weights used citations.

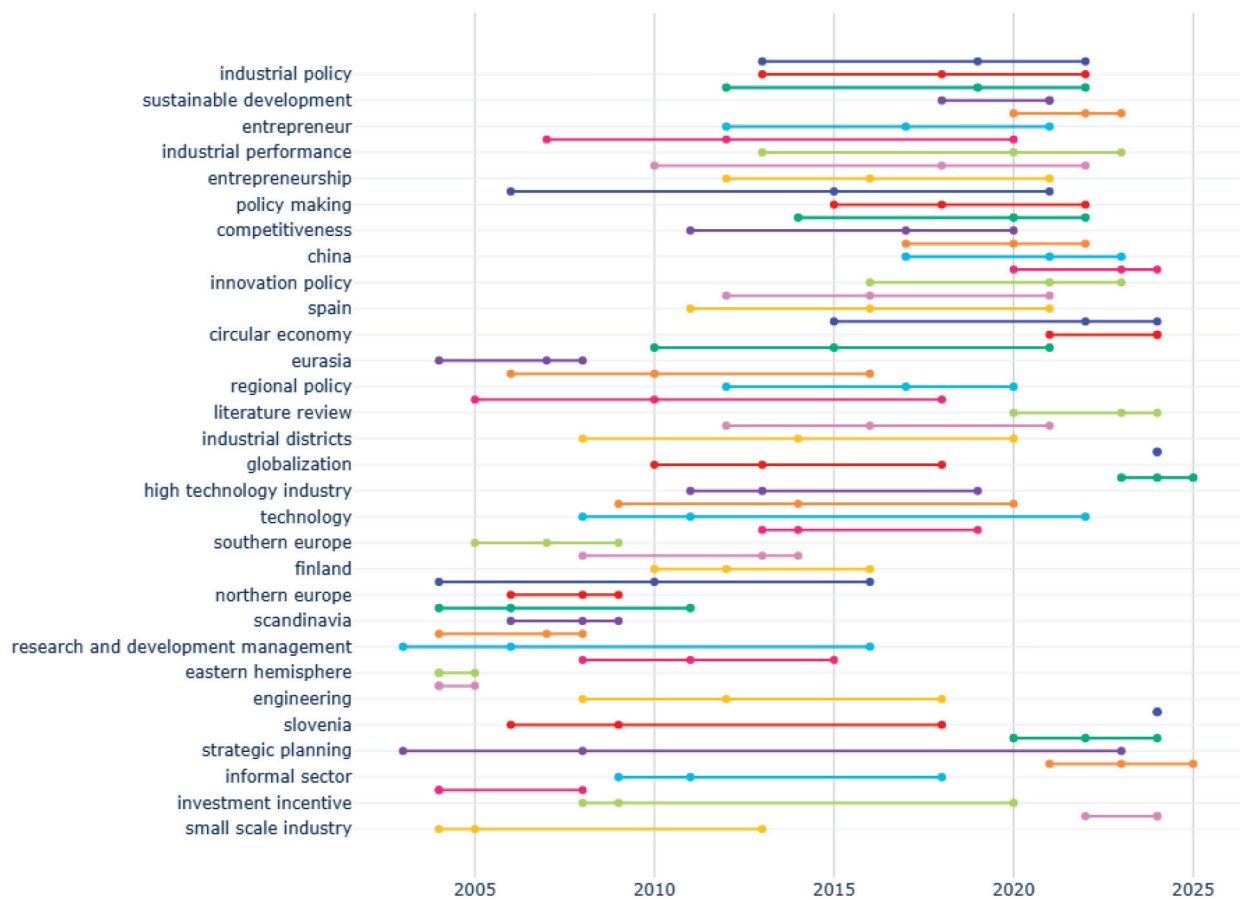
**Figure 5. Historiography of impactful authorship**

Source: Author's analysis via Biblioshiny.

#### 4.4 Keyword analytics of trend topics

Figure 6 visualizes the trend topics generated from 9,957 keywords in the dataset. Keywords 'Europe', 'industrial policy', and 'entrepreneurship' dominate the frequency, given their substantial meaning to the dataset. The temporal distribution of these terms highlights a gradual shift toward contemporary challenges, e.g., 'sustainability', 'circular economy', and 'digital transformation', which exhibit rising importance in recent years (median years: 2022, 2023, and 2023, respectively). Geographically, keywords 'Southern Europe', 'Scandinavia', and 'Slovenia' emerge as focal regions, aligning with historical studies on industrial districts and clustered economies. However, the increasing frequency of 'China' and 'globalization' signals a growing emphasis on non-Western contexts and global interdependencies. The term 'industrial districts', with a median year of 2014, retains relevance but is increasingly intertwined with newer concepts like 'Industry 4.0' and 'smart factories', reflecting adaptations to digitalization and automation. Similarly, 'technology transfer' and 'research and development' demonstrate continuing importance, though their applications now extend to sustainability-focused innovations, as evidenced by overlaps with 'green development' and 'carbon emissions'.

**Figure 6. Trend topics**



Source: Author’s analysis via Biblioshiny, reproduced via Phytion.

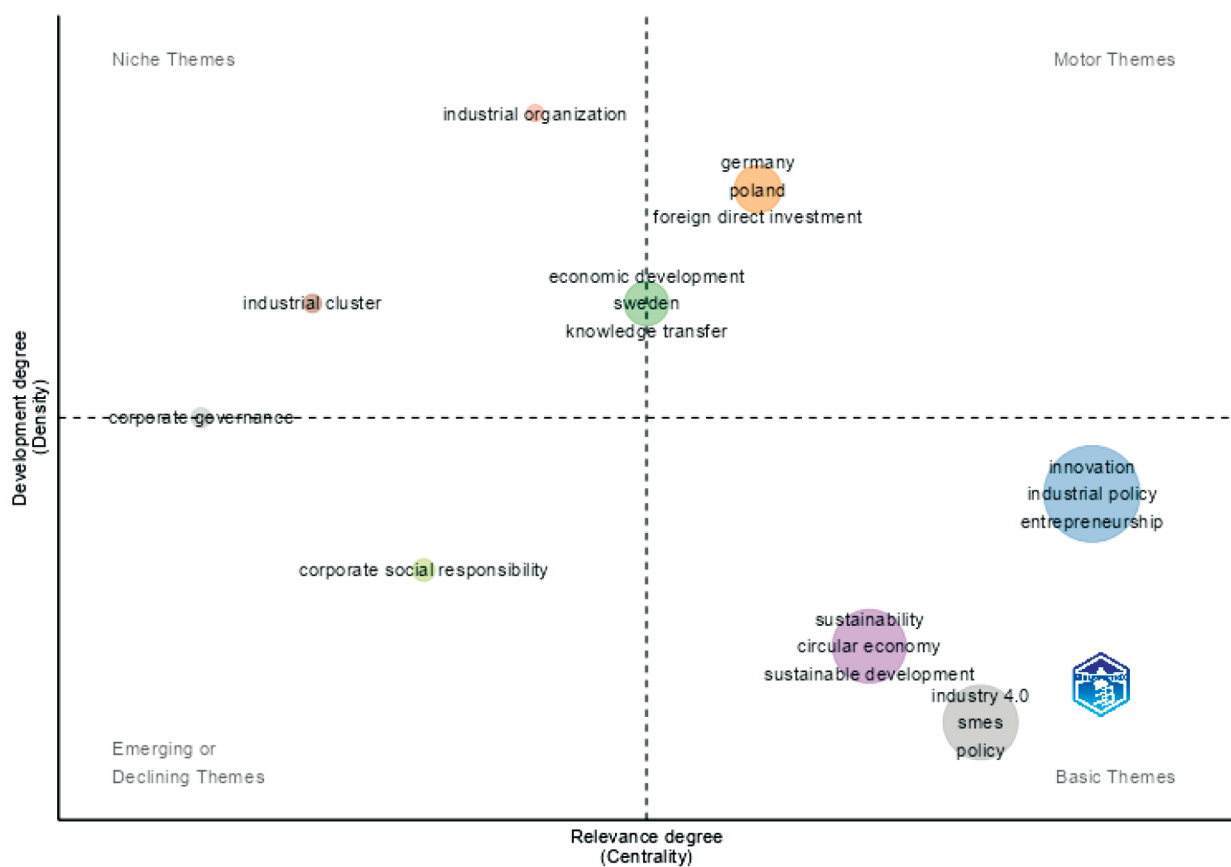
#### 4.5 Thematic map and evolution

As in *Figure 7*, the thematic analysis was generated from the keywords (n=9,957) in the dataset. Central to the motor themes (high relevance, low density) are innovation, industrial policy, and entrepreneurship, which dominate the discourse, driven by policy requirements and technological disruption. In contrast, basic themes (high density, high relevance), e.g., sustainability, circular economy, and Industry 4.0, underscore foundational shifts toward ecological and digital transformation. Their clustered positioning highlights interdisciplinary meetings, particularly in addressing climate resilience and smart manufacturing. Geographical emphases, e.g., Sweden, Germany, and Poland, emerge as hubs for knowledge transfer and economic development, bridging niche and mainstream agendas. Niche themes (high density, low relevance), including industrial organization and corporate governance, retain specialized attention but lack broader traction. Meanwhile, emerging/declining themes, e.g., corporate social responsibility and sustainable development, span both relevance and usefulness, suggesting transitional phases in the dataset.

Furthermore, the thematic evolution depicted in *Figure 8* reflects a shifting scholarly focus from foundational industrial concepts to contemporary policy-driven and sustainability-oriented frameworks. Early research (1990–2007) centered on industrial districts and clusters, emphasizing localized economic structures and empirical analyses of regional development. Keywords like ‘industrial district’ and ‘industrial clusters’ dominated, often linked to studies

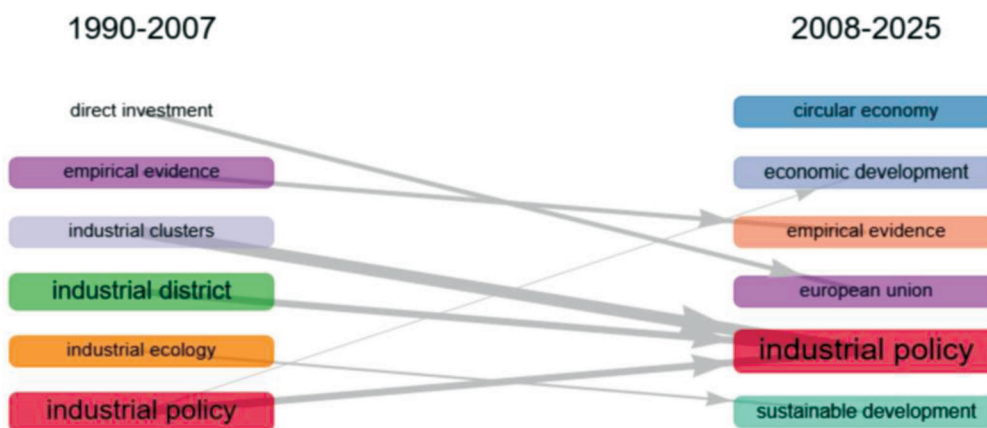
of European Union policies and foreign direct investment (FDI), as evidenced by the transition from direct investment (1990–2007) to foreign direct (2008–2025). This period also prioritized empirical evidence, which might show a methodological commitment to data-driven insights. By the 2008–2025 period, themes expanded to address global sustainability and systemic innovation. The evolution of ‘industrial policy’ (1990–2007) into ‘circular economy’ (2008–2025) highlights a hinge toward environmental stewardship, although with a low inclusion weight, suggesting emerging exploration. Conversely, the strong persistence of ‘industrial policy’ into ‘innovation policy’ signals its continuing relevance, now reframed through technological advancement and regional development. Notably, ‘sustainable development’ emerged as a critical connection, bridging earlier work on ‘industrial ecology’ (1990–2007) and reflecting growing urgency around ecological balance.

**Figure 7. Thematic map**



Source: Author’s analysis via Biblioshiny. Unit Analysis: Author’s keywords (n=9957).

**Figure 8. Thematic evolution**

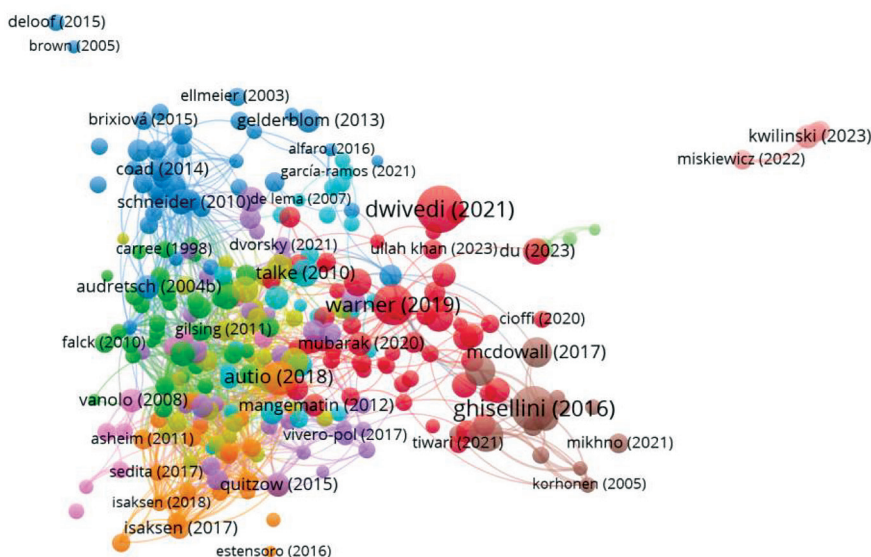


Source: Author’s analysis via Biblioshiny. Unit analysis (title of the manuscripts, n=2150)

### 5 Bibliographic coupling

Bibliographic coupling measures the similarity between documents based on shared references, indicating common research interests and thematic connections (Apriantoro et al., 2023; El Ashfahany et al., 2025). The analysis unit for bibliographic coupling in this study comprises n=2150 documents. This paper employed normalized citations for rectifying the temporal bias in citation counts, ensuring that recently published works are not disadvantaged compared to earlier manuscripts (Hudaefi, 2025). Such a normalized citation method is critical to effectively discover the newly important works on entrepreneurship debates within the EU’s industrial policy.

**Figure 9. Bibliographic coupling**



Source: Author’s analysis via VOSviewer. Unit analysis: 2150 documents. Included in the analysis: 287 selected manuscripts with 50 citations. Normalization method: association strength. Clustering: resolution 1.00, Min. cluster size 1 with merging small clusters.

*Figure 9* is the bibliographic coupling, which reveals distinct clusters of scholarly collaboration and thematic conjunction within the dataset. The map's structure underscores how shared references form interdisciplinary bridges, with environmental management, technological forecasting, and circular economy themes filling multiple clusters. Central to the network is a densely interconnected red cluster dominated by Dwivedi et al. (2021) and Warner and Wäger (2019), both highly cited (2,257 and 1,756 citations, respectively), indicating their foundational role that links diverse research elements. These nodes connect to newer works, e.g., Mubarak and Petraite (2020) and Ullah Khan et al. (2023), suggesting ongoing dialogues on sustainability, innovation, and entrepreneurship. A blue cluster anchored by Brown et al. (2005) and Deloof and La Rocca (2015) reflects older, yet influential contributions to regional innovation and knowledge transfer. In particular, Kwilinski et al. (2023) and Miskiewicz (2022) form a marginal pink cluster, highlighting emerging topics, e.g., land-use dynamics and policy frameworks.

## 6 Discussion

The bibliographic coupling analysis, visualized in *Figure 9*, reveals 11 distinct thematic clusters that reflect key research paths in entrepreneurship issues within the EU's industrial policy. These clusters are identified based on their spatial distribution, color coding, and citation networks in the visualization. This section further discusses the most impactful clusters, highlighting their intellectual contributions, key authors, and theoretical implications.

### 6.1 Sustainability and green entrepreneurship

Dominated by red nodes, centers on sustainability transitions, circular economy, and green entrepreneurship. Key authors include Appolloni et al. (2022); Büchi et al. (2020); Ullah Khan et al. (2023), whose works explore the interaction between environmental strategies and industrial performance. Ullah Khan et al. (2023) underscore green leadership and knowledge sharing in manufacturing, while Appolloni et al. (2022) analyze green recovery in mature industries through sustainability certifications. In addition, Büchi et al. (2020) examine smart factory performance in Industry 4.0. This cluster underscores the growing urgency of integrating ecological and economic objectives, with studies frequently cited in journals like *Technological Forecasting & Social Change* and *Ecological Economics*.

### 6.2 Industrial policy and innovation systems

A prominent blue cluster, with impactful work of Brown et al. (2005) and Carree and Thurik (1998), focuses on industrial policy, innovation diffusion, and the role of institutions in fostering technological innovation. Carree and Thurik (1998) initiated research on small firm dynamics in Europe, while Brown et al. (2005) investigated growth determinants in Romanian SMEs. This cluster also includes Schaltegger (2002), who conceptualizes ecopreneurship, linking environmental management to small business strategy. Despite its foundational role, this cluster exhibits lower citation rates compared to newer themes, suggesting a shift toward more applied sustainability research.

### **6.3 Regional development and knowledge spillovers**

The purple cluster, led by Asheim et al. (2011) and Vanolo (2008), examines regional economic strategies, knowledge spillovers, and the geography of innovation. Vanolo (2008) critiques urban branding in Turin, while Asheim et al. (2007) analyze knowledge-based regional advantage. This cluster bridges economic geography and innovation studies, with important contributions, e.g., Falck et al. (2010), evaluating the impact of cluster-oriented policies in Germany. These nodes often intersect with other clusters, reflecting the cross-disciplinary nature of regional development research.

### **6.4 University-industry-government interactions**

The orange cluster, highlighted by Mangematin and Walsh (2012), groups the works addressing the triple helix collaborations and knowledge transfer mechanisms. Autio et al. (2018) explore how universities contribute to industry innovation, while Mangematin and Walsh (2012) divide the role of intermediaries in technology transfer. This cluster also includes Gatto and Re (2021), who analyze circular bioeconomy business models. Despite its theoretical richness, this cluster faces challenges in practical application, as noted in Caloghirou et al. (2021), which identifies barriers to industry-university knowledge flows during crises.

### **6.5 SMEs and entrepreneurial ecosystems**

The orange cluster, centered on Isaksen and Tripl (2017) and Sedita et al. (2017), addresses SME resilience, entrepreneurial ecosystems, and digital transformation. Isaksen and Tripl (2017) examine new industrial paths in peripheral regions through synthetic routes, emphasizing exogenous knowledge and policy interventions, challenging conventional models with Norwegian and Austrian case studies. Meanwhile, Sedita et al. (2017) identify related variety and symbolic knowledge bases as key drivers of regional resilience, evidenced by Italy's post-2008 employment recovery, with policy implications for fostering economic adaptability through cultural and knowledge-led strategies. This cluster also incorporates Doloreux (2017), who defines maritime clusters, illustrating the diversification of SME research beyond traditional manufacturing.

## **7 Practical implications**

The identified thematic clusters may offer actionable insights for policymakers and entrepreneurs, aligning with EU policy frameworks. For sustainability and green entrepreneurship, the emphasis on circular economy and Industry 4.0 innovations (e.g., Ullah Khan et al., 2023) may underscore the need for EU policymakers to strengthen the European Green Deal via incentivizing green certifications and funding eco-innovation hubs. Entrepreneurs can leverage these findings to adopt sustainability certifications and knowledge-sharing networks, thus enhancing competitiveness.

In industrial policy and innovation systems, the declining citation rates of foundational studies (e.g., Carree & Thurik, 1998) suggest a need to modernize the EU SME Strategy. This way may be done through integrating newer themes, e.g., digital transformation into support programs, and hence, ensuring SMEs adapt to evolving markets. For regional development,

the focus on knowledge spillovers and cluster policies (e.g., Falck et al., 2010) aligns with the European Regional Development Fund, calling for tailored regional strategies that amplify localized strengths, e.g., Germany's cluster initiatives.

Lastly, SMEs and ecosystems research (Isaksen & Trippl, 2017) advocates for policies promoting related variety in knowledge bases, investigating the emergence of novel industries in two remote areas, i.e., the electronics and software sector in Arendal-Grimstad, Norway, and the software industry in Mühlviertel, Austria. These insights bridge scholarly findings to EU policy tools, enabling targeted interventions for sustainable and inclusive industrial growth.

## 8 Conclusion and limitations

This study provides an analysis of the intellectual landscape in the domain of entrepreneurship issues within the EU's industrial policy through bibliographic coupling and citation metrics. With a sample of 2,150 scholarly works and leveraging normalized citation frameworks, this research identifies key academic sources, influential manuscripts, and thematic clusters. Key findings reveal the centrality of journals, e.g., *Entrepreneurship and Regional Development* and *Sustainability*, in advancing debates on entrepreneurship with the EU's industrial policy innovation and policy, while foundational works, e.g., Ghisellini et al. (2016) on circular economy and Dwivedi et al. (2021) on artificial intelligence, underscore the field's interdisciplinary range. The bibliographic coupling further outlines thematic clusters, with green leadership, digital ecosystems, and land-use policy emerging as critical nodes bridging historical and emerging research agendas. Notably, the analysis highlights the continuing relevance of classical theories, e.g., Porter's Competitive Advantage of Nations, while emphasizing the need to address temporal biases in citation practices to ensure equitable recognition of recent contributions.

A key limitation of this study is the exclusive use of Scopus data, which underrepresents non-English, regional journals, and grey literature, potentially marginalizing EU country-specific contributions to entrepreneurship and industrial policy. In addition, Scopus' unavailability of policy reports in the database may skew the findings toward Anglophone perspectives. That is, these may underestimate regional policy debates and cross-lingual research, limiting our study's generalizability. Thus, future works may combine Scopus with other databases, e.g., Web of Science, Dimensions, or regional repositories to enhance coverage of non-English and policy-oriented sources, ensuring a more equitable representation of global scholarly databases.

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