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INTELLECTUAL CAPITAL IN MACROECONOMIC DISCOURSE: A BIBLIOMETRIC MAPPING

INTELEKTUÁLNY KAPITÁL V MAKROEKONOMICKEJ DISKUSII: BIBLIOMETRICKÉ MAPOVANIE

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Abstract: *This paper, based on a bibliometric review, explores the link between intellectual capital and macroeconomic factors in the public policy literature, focusing on trends, themes, and gaps, particularly in human capital mobility. It highlights the close connection between inflation and monetary policy, while areas such as growth and economic modelling are examined less. Analysing 8,759 documents from 1917 to 2025 across 718 sources, it uses co-word analysis, co-citation mapping, and thematic clustering to trace research developments. Despite increased attention to macroeconomic outcomes, issues such as brain drain and knowledge mobility remain underrepresented, revealing key gaps and guiding policymakers and scholars in better integrating human capital strategies.*
Keywords: *intellectual capital, brain drain, inflation, economic growth, public policy*
JEL Classification: O15, O34, E31, E20.

Introduction

In today's global economy, intangible resources – especially knowledge, innovation, and human skills – are becoming more important than traditional production factors. The idea of intellectual capital has thus become a key tool for understanding long-term economic growth and a nation's competitiveness. Its ease of movement – whether outward or inward – fundamentally influences the dynamics of national economies and has gained increasing scholarly attention.

In modern knowledge-driven and globalised economies, concerns about brain drain are quite common. The reasons for brain drain vary, ranging from educational opportunities abroad to better quality of life there. Brain drain is a phenomenon where a nation cannot effectively utilise its human resources or capital. This phenomenon is broadly categorised into internal brain drain and external brain drain. Internal brain drain pertains to domestic personnel with specialised skills being employed in roles unrelated to their fields of expertise. External brain drain, on the other hand, describes the condition in which proficient talents of a country reside abroad, thereby contributing their productivity to the economies of other nations (Yu, 2021).

Intellectual capital is primarily represented by human capital in brain drain. This connection highlights how the loss of skilled individuals can significantly impact a country's innovative capacity and economic development, as human capital is a key component of intellectual capital. In that case, human capital can be defined as a key driving factor of countries. According to Yu (2021) the patterns of brain drain differ significantly between countries, with South Korea experiencing a continuous outflow of talent, while China sees a decline in its brain drain. Despite common perceptions that brain drain negatively impacts economic growth, research indicates it can positively affect productivity and overall economic growth through productivity gains and knowledge sharing. The migration of qualified human capital and their stay in the U.S. significantly positively affect economic and productivity growth. Differences between countries cannot be explained solely by the individual preferences of economic agents, but also by the broader institutional and public policy conditions that shape the decisions of skilled labour. Factors such as the quality of the education system, wage levels, price stability, and opportunities for career advancement directly influence whether skilled labour remains tied to the domestic economy or leaves for abroad. For countries of origin, however, brain drain risks weakening key sectors, particularly when it involves specialised fields with high added value. In addition to cross-country differences, it is also necessary to examine the internal dynamics of individual regions. While more developed regions may benefit from the inflow of skilled professionals, less developed ones often struggle with structural challenges such as wage disparities, limited research funding, or weaker institutional frameworks. Such differences can contribute to the deepening of regional inequalities, as the lack of human capital in certain areas weakens their ability to attract investment, foster innovation, and maintain long-term competitiveness. These dynamics highlight the importance of public policy and governance frameworks in shaping human capital mobility and its economic consequences.

The relationship between brain drain, economic growth, and inflation is complex and requires systematic examination, particularly in the context of public policy and economic governance. This study approaches the issue through a bibliometric analysis of scientific publications indexed in the Web of Science database, covering the period from 1917 to 2025. This approach enables the identification of key research trends and thematic interconnections within a global research landscape.

The main aim of this article is to systematically examine the relationship between intellectual capital, brain drain, and selected macroeconomic factors through a bibliometric approach. The study seeks to systematically identify dominant research trends, thematic structures, and the evolution of key concepts within the existing literature. Secondary aims include examining the geographical distribution of scientific output and international collaboration, as well as identifying underexplored areas, particularly in relation to human capital mobility and its relevance for public policy and economic governance.

The article addresses the research problem of how intellectual capital, particularly its component represented by human capital mobility, is reflected in the broader discourse on macroeconomic performance and public policy. Based on this, the study formulates the following research questions: (1) What are the dominant themes and research trends in the literature linking intellectual capital and macroeconomic factors? (2) How is brain drain positioned within this research field, and to what extent is it integrated into the core macroeconomic discourse? (3) What implications do the identified thematic patterns have for public policy and economic governance? These questions are justified by the fragmented nature of existing research, which often analyses these factors separately and does not sufficiently reflect their interconnections or policy relevance.

Methodologically, the study is based on a bibliometric approach, which enables a systematic analysis of scientific literature and the identification of patterns in the development

of the research field. Selected techniques, such as co-word analysis, co-citation mapping, and thematic clustering, are applied to examine relationships between key concepts and thematic structures. This approach allows for a comprehensive understanding of how research on intellectual capital, brain drain, and macroeconomic factors has evolved over time.

Existing research on intellectual capital, brain drain, and macroeconomic performance has expanded significantly, particularly in the fields of economics, management, and development studies. However, these strands of research are often developed separately, with limited integration of human capital mobility into broader macroeconomic and policy-oriented frameworks. As a result, the interaction between brain drain, macroeconomic stability, and public policy remains insufficiently explored. This article contributes to the existing literature by providing a systematic bibliometric mapping of the research field, thereby offering a more integrated perspective and highlighting its relevance for public policy and economic governance.

The article is structured as follows. The first section presents the theoretical background and reviews the relevant literature. The second section describes the data collection and methodology. The third section presents the results of the bibliometric analysis. The final section discusses the findings, outlines the limitations of the study, and highlights implications for public policy and future research.

1 THEORETICAL BACKGROUND

Economic growth cannot be understood merely as a statistical indicator in the form of GDP growth. In general, it is a process that reflects a society's ability to develop its production factors, with the human factor playing a decisive role. The quality and availability of human capital determine whether growth will be sustainable or exhausted (Lucas, 1988; Romer, 1990; Barro, 1991). From this perspective, it is clear that education, innovation, and the migration of skilled labour are closely related to the pace of economic growth. Economic growth is therefore not only the outcome of economic policies but also a mirror of how well an economy can sustain and enhance its intellectual capital.

Inflation is another significant factor in this dynamic. At first glance, it appears to be a technical indicator, yet in reality it fundamentally shapes the decision-making of both individuals and institutions. Stable and predictable prices create an environment in which investing in education and research is worthwhile, since the real value of returns on such investments is preserved (Fischer, 1993; Barro, 1995). Conversely, when inflation persistently outpaces wage growth, the motivation to remain in less flexible sectors diminishes, and the pressure to move abroad increases. Inflation thus affects not only households' purchasing power but also people's long-term willingness to tie their human capital to the domestic economy. The issue of the impact of wage dynamics and cross-country differences on the migration of highly skilled labour is analysed, for example, by Grossmann and Stadelmann (2013).

The connection between economic growth, inflation, and human capital mobility (often called the "brain drain") is therefore clear. Countries that can sustain stable growth and low inflation not only create a favourable environment for investment but also offer attractive conditions for skilled workers to find employment. Conversely, stagnation combined with price instability diminishes the motivation to stay, as it lowers the real value of incomes and restricts chances for professional growth. The issue of "brain drain" is thus not solely about individual choices but is deeply rooted in macroeconomic factors that influence the return on investment in education and innovation. Higher and unpredictable inflation acts as a push factor, while a stable price environment, regular wage adjustments, and better funding of workplaces in destination economies enhance the pull effect (Khan et al., 2023).

Human capital is a part of the known triad of intellectual capital. Human capital is defined as a combination of knowledge, skills, innovativeness, and abilities of individual employees of a company to fulfil a given task. It also encompasses the values, culture, and philosophy of the company. The company cannot own human capital (Bontis, 2002). From a macroeconomic perspective, it represents an aggregate of abilities directly tied to people, and is therefore a naturally mobile resource. The migration of the highly skilled thus constitutes the main channel through which intellectual capital is transferred across countries. In the domestic economy, brain drain may reduce the availability of specialised skills, dampen productivity, and slow down innovation processes within firms and institutions; at the same time, it alters wage dynamics and indirectly influences price pressures, particularly when workers in key sectors leave (Beine, Docquier & Rapoport, 2001; Kapur & McHale, 2005).

Although much research concentrates on the short-term losses caused by the emigration of highly skilled labour, the literature also presents a more nuanced picture. According to the synthesis by Docquier and Rapoport (2012), brain drain has become the dominant pattern of international migration and a significant facet of globalisation. In this way, globalisation intensifies inequalities — human capital flows from countries where it is limited to those where it is plentiful. However, the review also shows that under certain conditions, skilled migration can produce positive effects, such as through network externalities. This raises the question of whether the overall influence on economic growth depends more on the sheer volume of migration or on the institutional framework and policies that influence countries' capacity to retain and develop human capital.

Research has traditionally emphasised the negative short-term impacts of brain drain on economic growth. Empirical studies such as Miyagiwa (1991), Haque and Kim (1995), and Galor and Tsiddon (1997) consistently indicate that the emigration of highly skilled individuals weakens an economy's capacity to harness knowledge externalities and diminishes the level of innovation. More recent analyses also emphasise the importance of macro-determinants of migration: Akyıldız, Başkol, and Eryiğit (2025), for Turkey from 1984 to 2022, investigate whether income levels, inflation, youth unemployment, and institutional quality significantly influence the outflow of skilled labour. These findings align with the push–pull framework.

The effects, however, are not uniform across countries and over time. Part of the literature points to mechanisms that may mitigate the negatives or, in the longer term, even shift the balance towards benefits. These include remittances, the return of migrants bringing new practices, knowledge transfer, or increased motivation for education among younger generations if they perceive a real opportunity to apply themselves either at home or abroad. Yu (2021) shows that in middle-income and faster-growing economies, a positive relationship emerges between brain drain and economic growth, which is interpreted as brain circulation and the effect of reverse knowledge transfer.

From a public policy perspective, the interaction between human capital mobility, inflation, and economic growth cannot be fully understood without considering the quality of the institutional environment and the state's capacity to effectively design and implement policies. Factors such as legal certainty, the efficiency of public administration, the structure of the education system, and support for research and innovation directly influence the returns on investment in human capital and the decisions of skilled labour to remain in or leave the domestic economy. In this context, the relationship between brain drain and macroeconomic performance is not only an economic issue but also a result of specific institutional conditions and the effectiveness of public policies.

2 DATA COLLECTION AND METHODOLOGY

The data collection process was conducted on 3rd September 2025 using the Web of Science database. Web of Science is a highly reputable and comprehensive scientific resource that provides access to various peer-reviewed journals and conference proceedings. Its rigorous selection process for included publications ensures the data's reliability and quality. Additionally, Web of Science offers advanced search and citation-tracking tools, making it easier for researchers to locate relevant information and assess the impact of scientific work. Its extensive coverage across multiple disciplines further supports its suitability as a trustworthy source for scientific research. Criteria used by filtering data are described in Table 1.

Table 1: Filter criteria for data collection

Keywords	(„Intellectual capital" OR „Human capital") AND („Brain drain" OR „Intellectual migration") AND („Economic growth" OR „Inflation")
Categories	Economics, Business Finance, Management, Business, Multidisciplinary Sciences Exclude all other
Research area	Business Economics
Document type	Article – open access
Language	English
Years	1917 – 2025 (Final publication year)
Sample size	9,259

Source: own processing

After removing duplicates from the sample, our final dataset comprises 8,759 documents authored by 17,627 individuals and published across 718 sources, such as journals. For further analysis, we also collected 6,623 author-provided keywords and 17,325 author-assigned keywords. The dataset covers publications from 1917 to 2025. The annual growth rate is approximately 6.22%. The average age of the documents is 6.7 years, with an average of 19.17 citations per document. Additional information is described in Table 2.

Table 2: General information about the collected sample

Description	Results
Timespan	1917 – 2025
Sources (Journals, Books, etc)	718
Documents	8,759
Annual Growth Rate %	6.22
Document Average Age	6.7
Average citations per doc	19.17
References	277,855
Keywords Plus (ID)	6,623
Author's Keywords (DE)	17,325
Authors	17,627
Authors of single-authored docs	1,719
Single-authored docs	1,976
Co-Authors per Doc	2.55
International co-authorships %	32.71

Source: own processing

The main bibliometric metrics analyse authors, affiliations, countries, and sources. By analysing authors and/or sources, the descriptive statistics mainly lie in the number of publications. It is also important not to ignore indices such as the h-index, g-index, and m-index. The h-index is widely used and recognised in academia and research evaluation, making it a valuable tool for benchmarking and comparisons. The h-index can be influenced by a single highly cited paper, which may not reflect the overall impact or consistency of a researcher's work. The h-index tends to increase over time, disadvantaging early-career academics or smaller institutions. Some of its limitations can be addressed by applying the "m-index," which can be especially useful for early-career researchers who may have a lower h-index but a high average citation impact. The m-index considers both the h-index and the total length of an academic's research career. However, it focuses solely on average citation impact and does not account for the total number of highly cited papers, which may limit its comprehensiveness. The g-index emphasises highly cited papers, providing recognition for the most influential contributions. Similar to the h-index, it is straightforward to calculate, requiring only citation counts and ranked papers. It balances both the total number of publications and the number of highly cited ones, offering a comprehensive view of research impact (Hassan & Duarte, 2024). The next important bibliometric tool is Lotka's law, which is a basic informetrics law used for analysing authors (similar to Bradford's law for sources). Lotka's law, named after Alfred J. Lotka, is a special application of Zipf's law that describes the frequency of publication by authors in any given field. Let's define X as the number of publications, Y as the number of authors with X publications, and k as a constant that depends on the specific field. Lotka's law states that $Y \propto X^{-k}$. Lotka initially claimed that $k = 2$, but subsequent research has shown that k varies depending on the discipline. Alternatively, Lotka's law can be expressed as $Y' \propto X^{-(k-1)}$, where Y' is the number of authors with at least X publications. These two expressions can be proven equivalent by taking the derivative (Qiu et al., 2017). The main bibliometric analysis tool for journals is Bradford's law. Bradford's law is a pattern first described by Samuel C. Bradford in 1934 that estimates the exponentially diminishing returns of searching for references in science journals. According to the law, if the number of articles sorts journals in a field into three groups, each with about one-third of all articles, then the number of journals in each group will be proportional: $1 : n : n^2$ (Naranan, 1970). In many disciplines, this pattern is called a Pareto distribution.

Researchers employ co-occurrence, co-authorship, and co-citation analysis to create networks. Co-occurrence analysis, widely used in text analysis and natural language processing, detects correlation patterns among words or terms within a textual corpus. It involves examining how often pairs of words or terms appear together in a document or textual unit. From this data, one can infer the dominant correlations among terms and expressions within the corpus (Xu et al., 2022). A common method for co-occurrence analysis is generating a co-occurrence matrix, which records the frequency of pairs of words or terms across the corpus. This matrix can then be analysed using techniques like clustering or factor analysis to identify recurring relationships among terms or concepts. Often, co-occurrence analysis is used to build a network or graph of the most frequent words or phrases. In this network, nodes represent individual words or terms, and edges indicate how often pairs of words or terms appear together. This network can be visually examined and analysed to identify clusters of related terms and deepen the understanding of the corpus's core structure (Liu & Mei, 2016). Co-authorship analysis is widely used to explore collaboration trends among researchers and their publications. This study critically examines co-author networks across various works to identify patterns such as co-authorship frequency, author centrality, and connection density. Analysing co-authorship helps understand interdisciplinary collaboration intricacies and the structure of research communities within specific fields. According to Mourao & Martinho (2020), this technique can detect emerging patterns and track the development of research topics over time. While co-

authorship analysis is common in academia, it is increasingly popular in industries and other sectors where collaboration is vital. Understanding collaborative relationships among authors can reveal potential partnership opportunities and improve research efficiency, as noted by Molontay & Nagy (2021). Citation analysis is a standard method for examining and evaluating scientific publications by analysing the references they receive from other works. Its goal is to determine the impact and influence of a specific publication, author, or research topic within a field. Often used to measure scholarly influence, citation analysis involves calculating various metrics like citation counts, h-index, and impact factor. These metrics help assess the quality and importance of publications, enabling comparisons among authors or works within similar areas. Additionally, citation analysis can reveal patterns and trends in scientific communication-for example, identifying the most cited authors or publications in a particular field, or tracking the development of a research theme over time. Conversely, co-citation analysis examines the relationships between documents based on shared citation patterns (Hota et al., 2020). Figure 1 presents the basic approach to conducting bibliometric analysis.

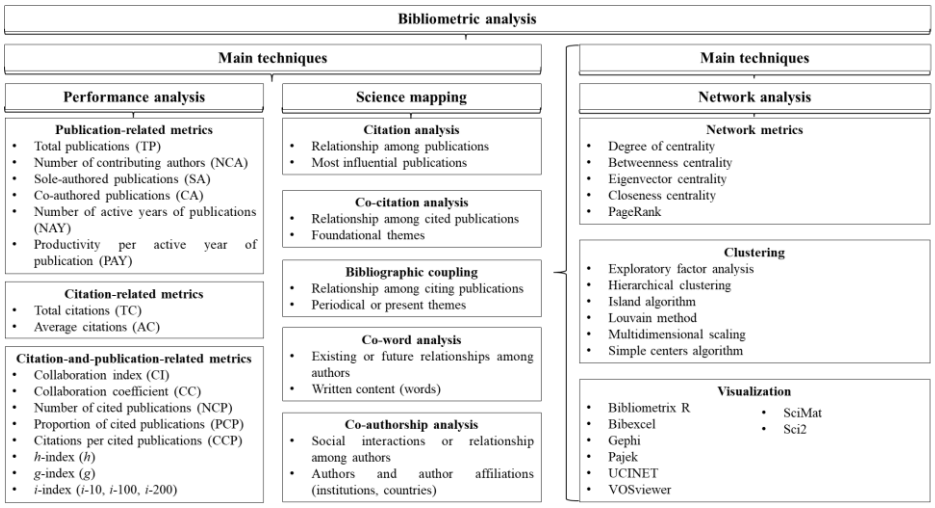

Figure 1: Toolbox of bibliometric analysis

Source: own processing according to Donthu et al. (2021)

Academics employ various qualitative and quantitative methods to review and synthesise previous research. Among these, bibliometrics stands out as a technique capable of offering a systematic, transparent, and reproducible review process through the statistical analysis of scientific outputs, researchers, or scholarly activities (Pritchard, 1969). Unlike other approaches, bibliometrics delivers more objective and dependable insights. In the context of the rapidly growing volume of new information, conceptual advancements, and data, bibliometrics becomes particularly valuable by providing structured analysis of extensive datasets. It enables identification of research trends over time, thematic focuses, disciplinary shifts, prominent scholars and institutions, and offers a comprehensive overview of existing research landscapes (Aria & Cuccurullo, 2017).

The bibliometric analysis was used as a primary methodology tool. We use the package „bibliometrix" in RStudio. The package was meticulously developed by Aria & Cuccurullo (2017), incorporating a comprehensive bibliometric methodology. It utilizes sophisticated techniques such as bibliographic coupling, co-citation analysis, co-authorship examination, and co-word analysis, ensuring a thorough and detailed approach to bibliometric research., co-author and co-word. This package contains several basic and advanced bibliometric tools described in detail in Figure 2.

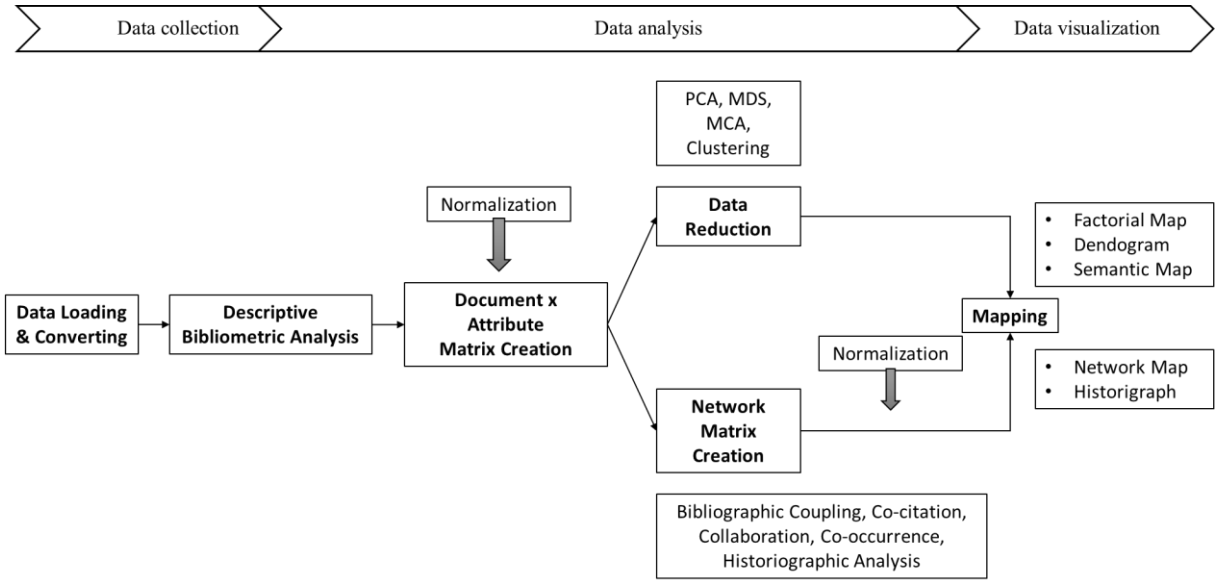

Figure 2: Bibliometrix workflow
Source: own processing according to the Aria & Cuccurullo (2017)

3 RESULTS AND DISCUSSION

Figure 3 shows how research output and citation impact have changed in the field from 1917 to 2025. For much of the 20th century, publication levels were low, with little activity until the late 1960s. The trends in scientific production and citation patterns come from various underlying factors. Before the 1970s, the number of published articles was very low, probably because there was limited academic focus on issues like intellectual capital, brain drain, and knowledge-based economic growth. As a result, the field had minimal visibility and research activity during that period. There is a small increase around 1970, but significant growth only happens in the late 1980s. The sharp rise in average citations per article during the 1970s and 1990s can likely be traced to a few highly influential, foundational studies published during those times. Since these works were among the limited research available then, they attracted considerable academic attention and were cited frequently. This led to unusually high citation averages despite a low number of publications. From 2000 onwards, research output grows rapidly, especially after 2010, reaching nearly 1,000 articles annually by 2025. This boost is linked to the growing importance of intangible assets, globalisation, and the shift towards knowledge-based economies. The expansion of digital publishing platforms, increased international collaboration, and more research funding — particularly in emerging economies — also played key roles in strengthening academic output in this area. Conversely, citation impact patterns differ; the red line indicates spikes in 1975 and 1990, each exceeding 16 citations, likely due to influential seminal papers. From the 1990s to the early 2000s, citation rates remained relatively high, reflecting ongoing interest. However, from 2010 onwards, citations gradually declined, and by 2025, the average citations per article fell below 2. This decline is probably attributable to the shorter citation window for recent papers and the sheer increase in publication volume, which reduces visibility for individual works. Overall, the figure illustrates a sharp rise in research output over the past two decades, accompanied by a relative decrease in average citation rates. This trend may be driven by increased competition, more publication outlets, or citation lag effects. Although research volume continues to expand, the data reveal a complex relationship between publication quantity and scholarly impact.

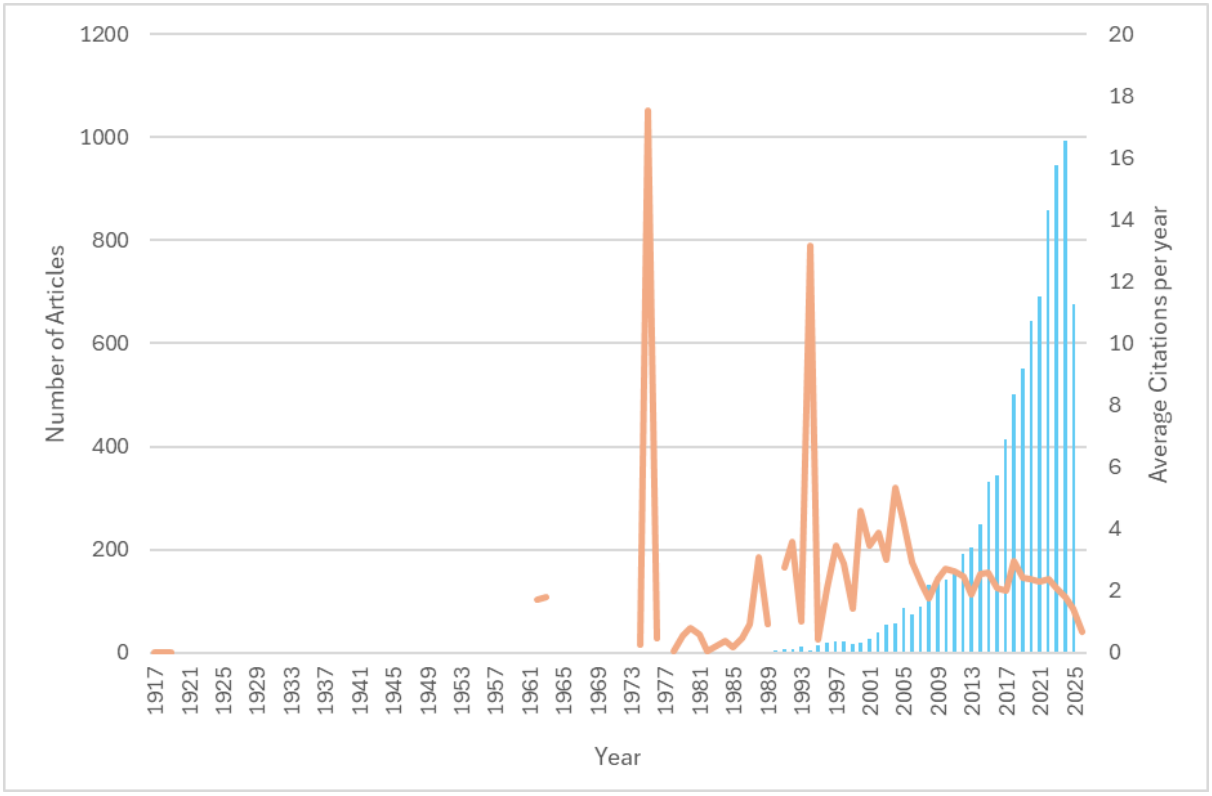

Figure 2: Timeline of publication and citation of bibliometric papers
Source: own processing

Figure 4 shows the worldwide distribution of scientific output in the analysed research field. Scientific publication activity reflects a country's capacity to create, accumulate, and disseminate knowledge and may therefore be regarded as one partial manifestation of intellectual capital. In this context, publication output is interpreted as an indicator of research and knowledge-production capacity, which may support innovation and long-term economic development, while recognising that intellectual capital also encompasses broader human, institutional, and structural dimensions. Research is heavily concentrated in wealthy nations such as the USA, UK, and Germany, while developing countries show limited activity. The United States ranks at the forefront globally with 4,014 documented scientific contributions, followed by the United Kingdom with 2,747, Germany with 1,406, Italy with 1,363, and China with 1,351. These nations benefit from strong institutional frameworks, substantial research and development funding, and policies that promote knowledge creation and preservation. Conversely, many developing and low-income nations in Africa, Latin America, and parts of Asia make only minimal contributions to global science. For example, Bolivia, El Salvador, and Jamaica each report just one scientific publication. This stark contrast highlights an increasing gap in intellectual influence. As conditions such as macroeconomic situation, public budgets, academic conditions, educational opportunities, research and development expenses, or legal systems vary greatly, for a better understanding of the publication landscape, we divide the world map into regions. North America is led by the United States and Canada, with the U.S. showing remarkably high output due to decades of consistent investment in higher education and research & development. Mexico's output is comparatively lower, highlighting the need for enhanced institutional support. Europe constitutes a heterogeneous and highly productive macro-region, with nations such as the United Kingdom, Germany, Italy, and Spain exemplifying leadership roles. Notably, Central and Eastern European countries — including Poland (794), Ukraine (883), and Romania (372) — have made substantial contributions to

regional development, despite frequently confronting challenges related to brain drain and insufficient funding for research infrastructures. Asia presents a varied landscape. China and India stand out as scientific leaders with increasing research investments, whereas countries like Indonesia, Malaysia, and Vietnam are also making promising strides. Nonetheless, nations such as Bangladesh (90) and Nepal (9) continue to face challenges, often due to economic and political instability. Scientific output across Africa remains generally low, with South Africa (605) leading significantly. Countries like Nigeria (221) and Ghana (182) demonstrate growing potential, though many others face challenges such as limited infrastructure, inadequate funding, and ongoing brain drain to more developed countries. Latin American nations show moderate levels of scientific activity. Brazil (346) leads the region, with Colombia (172) and Chile (108) following. Nonetheless, inflation and political instability frequently impede consistent academic and scientific development. Australia (701) and New Zealand (117) have robust research systems in Oceania. Their high research output is supported by stable economies, leading universities, and strong connections to international academic networks. Turkey (486) and Iran (116) lead the region in productivity, with Gulf countries like Saudi Arabia (136) and Qatar (26) quickly increasing their investment in higher education and science. Conversely, conflict-affected nations such as Iraq and Yemen have very limited output because of persistent instability. This highlights issues like brain drain and unequal access to research funding. Broader macroeconomic factors — such as inflation and economic instability — often influence these disparities by restricting countries' investments in education and innovation. From a public policy perspective, these findings indicate the need for targeted support of research capacities, a stable macroeconomic environment, and measures aimed at retaining and attracting back highly skilled labour. Policies focused on strengthening education systems, funding research, and creating attractive working conditions for researchers can help mitigate regional disparities and enhance global competitiveness. Understanding these dynamics is therefore essential not only for analysing the global distribution of scientific output, but also for designing effective public policies that support long-term economic development.

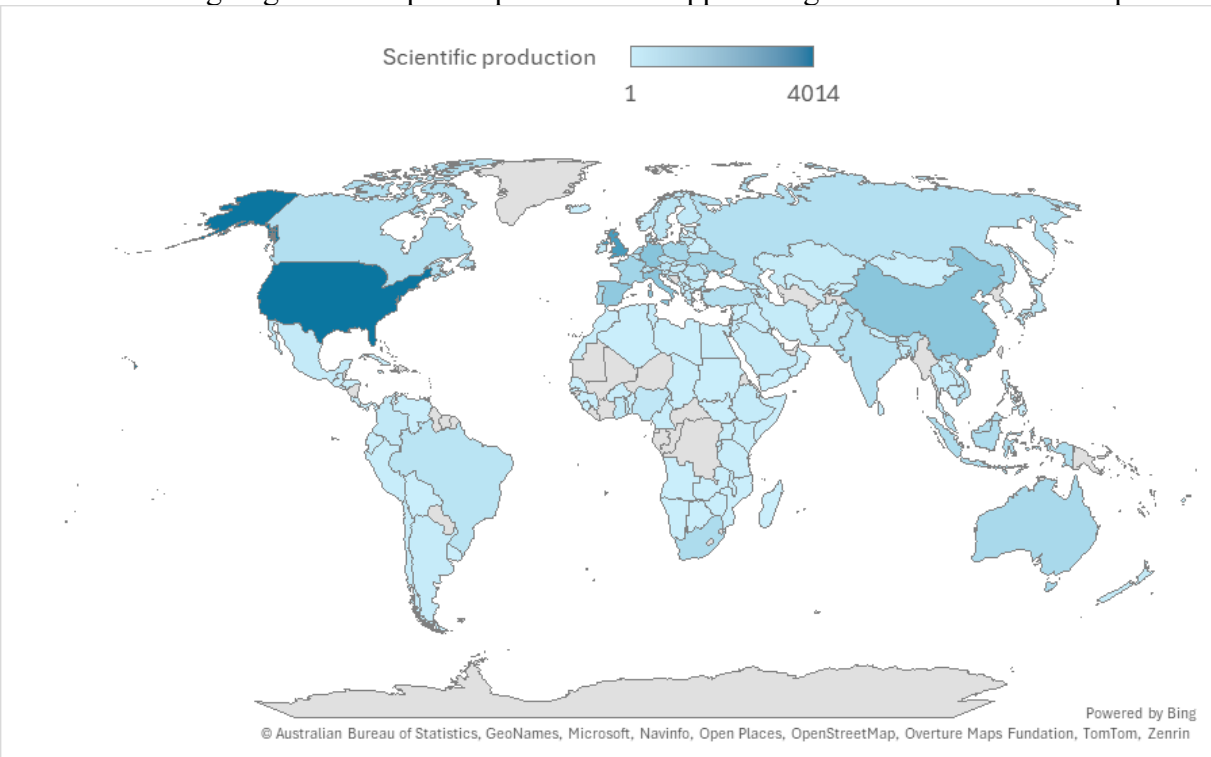

Figure 3: Publication map
Source: own processing

To better understand the potential for country collaboration, we analyse the authors from different countries. Figure 5 shows that, although the USA is the most collaborative and productive nation, many others depend heavily on national research. Countries with higher MCP values tend to be more connected within global research networks, which can improve their visibility, citation impact, and foster innovation through diverse viewpoints.

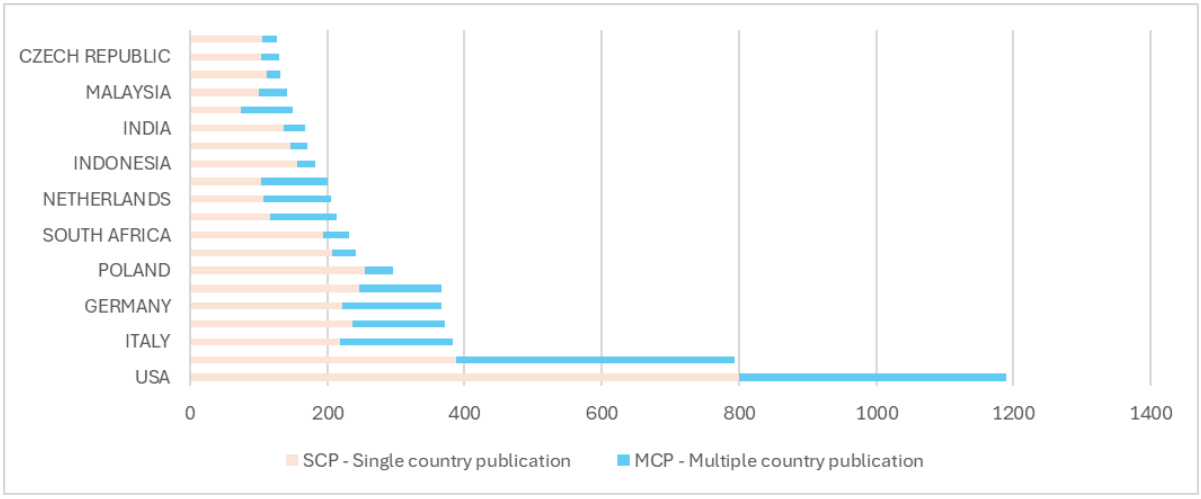

Figure 4: Corresponding author's country
Source: own processing

The sources from which these publications were published were analysed using Bradford's law, as illustrated in Figure 6. The sources distribution follows a classic long-tail pattern consistent with Bradford's Law, which indicates that a small number of journals — referred to as the "core" — publish a disproportionately large share of articles on a specific topic. In this analysis, this trend is clear: journals such as Cogent Economics & Finance, Economies, and the Journal of Money, Credit and Banking each publish over 100 articles related to the subject. These frequently published journals serve as core sources, forming the foundation of scholarly discourse in the field. The shaded area in the accompanying chart highlights this core zone. Beyond this group, the number of articles per journal drops sharply, suggesting that the remaining publications are spread across numerous less specialised or interdisciplinary outlets. The distribution observed may be attributed to the interdisciplinary nature of the topic, which includes economics, finance, management, and policy studies. Consequently, while the core journals anchor the research landscape, contributions from peripheral sources enrich the field with diverse perspectives and methodologies.

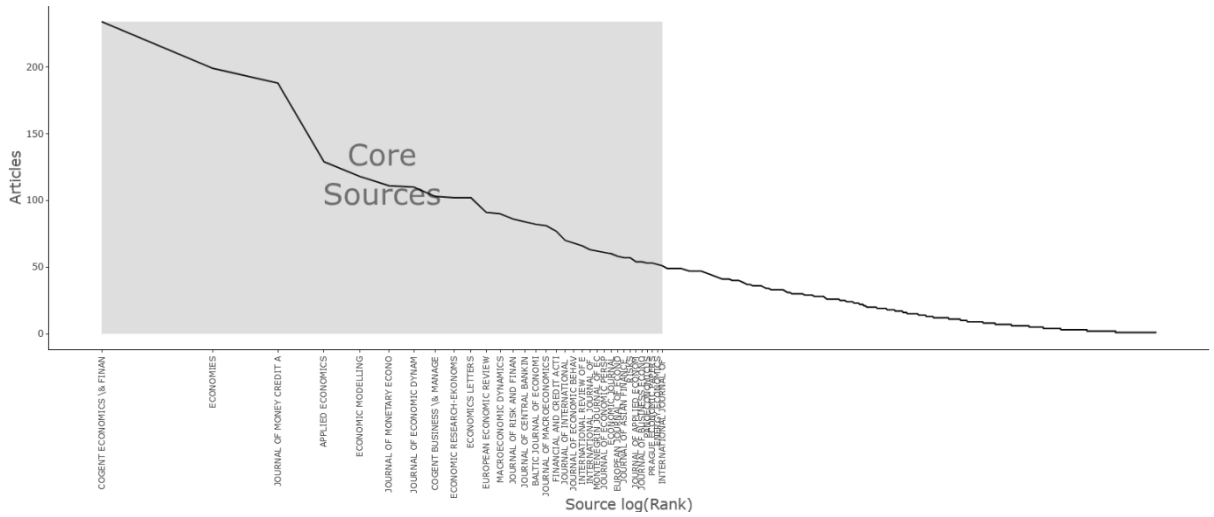

Figure 5: Core Sources by Bradford's Law
Source: own processing

While the number of publications shows how productive a journal is, the h-index gives us a more complete picture of its influence by looking at how many articles it publishes and how often they're cited. Comparing these measures reveals that publishing a lot doesn't always mean a journal is more impactful. For instance, the Journal of Money, Credit and Banking has the most articles (188), but its h-index (41) is lower than that of the Journal of Economic Perspectives, which has 161 publications but a higher h-index of 44 (see Figure 7). This suggests that articles in the Journal of Economic Perspectives tend to be cited more regularly and have a greater influence in the academic world. Similarly, journals like Applied Economics and Economic Modelling, with many publications — 24 and 23 respectively — show lower h-index scores, indicating that although they publish frequently, their articles might not be cited as often or as consistently as those in journals with fewer but more influential publications. This difference highlights that the h-index reflects the quality and impact of work rather than just quantity. It underscores the value of consistent citation performance across a journal's publications and shows that having some high-impact articles is not enough if overall citations are low. So, while publication count helps show how busy a journal is, the h-index clearly indicates its actual scholarly influence and importance in the field.

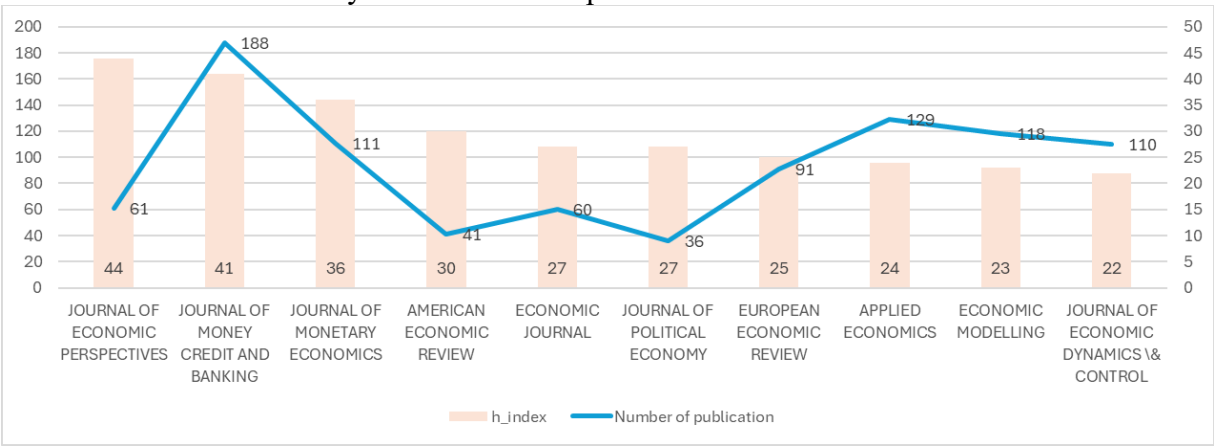

Figure 6: Relevant sources based on Hirsch index
Source: own processing

Similar to Bradford's Law for Journals, we provide Lotka's Law for authors, illustrated in Figure 8. The data presented delineate the distribution of authors categorised by the number of publications they have produced. The distribution exhibits a pronounced right-skewed pattern,

consistent with Lotka's Law, which posits that the number of authors publishing n papers is inversely proportional to n squared. In practical terms, most authors contribute a single publication, whereas a minority account for a disproportionately high volume of outputs. Specifically, 84.3% of authors (n=14,858) have authored only one publication, 10.4% have authored two publications, and a mere 5.3% have authored three or more. Authors with more than ten publications, classified as highly prolific, constitute less than 0.1% of the total author cohort. This exponential decline in author productivity as the number of publications increases is corroborated visually by the preceding curve, which demonstrates a steep decline after a single publication, subsequently plateauing as the number of publications increases.

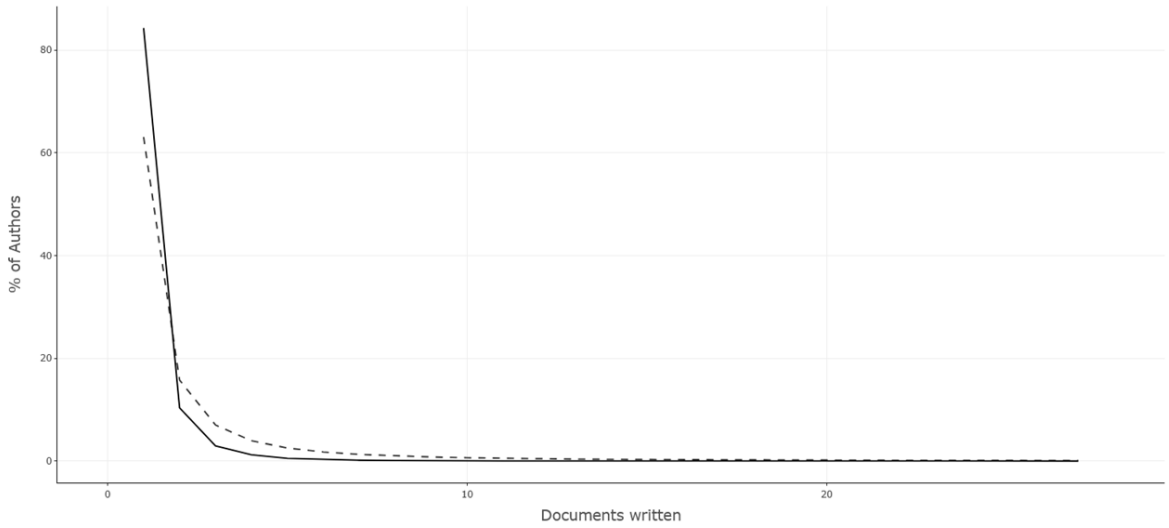

Figure 7: Lotka's Law
Source: own processing

We provide a comprehensive overview of authors, similar to the description of sources, including the number of published articles and authors' h-index, illustrated in Figure 9. Gupta R. emerges as the most influential and prolific scholar within the analysed cohort, exhibiting the highest h-index (27) and the most significant number of publications (12). This dual achievement underscores a consistent scholarly productivity coupled with considerable citation impact. Following closely are Zhang J. and Nasir M.A., with h-indices of 22 and 20, respectively, and publication counts of 12 and 11, indicating substantial scholarly contributions, albeit slightly below Gupta R.'s metrics. Notably, specific authors such as Cuaresma J.C. and Benchimol J. possess identical publication counts (9) but differ in their h-indices (16 vs. 11), suggesting variability in citation frequency or scholarly influence per publication. Authors like Heckman J.J. and Hommes C., with publication counts of 8–9 and h-indices of 10, may reflect less frequent contributions or the influence of seminal older works within this domain. The data demonstrate that prolific publication output does not necessarily correlate with higher scholarly impact. For instance, Campbell J.Y. has authored 10 papers but exhibits an h-index of 12, which is lower than some authors with fewer publications. Conversely, Cuaresma J.C.'s higher h-index (16) relative to his publication count indicates a greater average citation per work, emphasising the importance of publication quality and influence. This pattern underscores the broader observation that publications' quality and scholarly impact — measured by the h-index — can vary significantly among authors, regardless of their publication volume. The h-index offers a nuanced perspective by capturing sustained citation relevance over time.

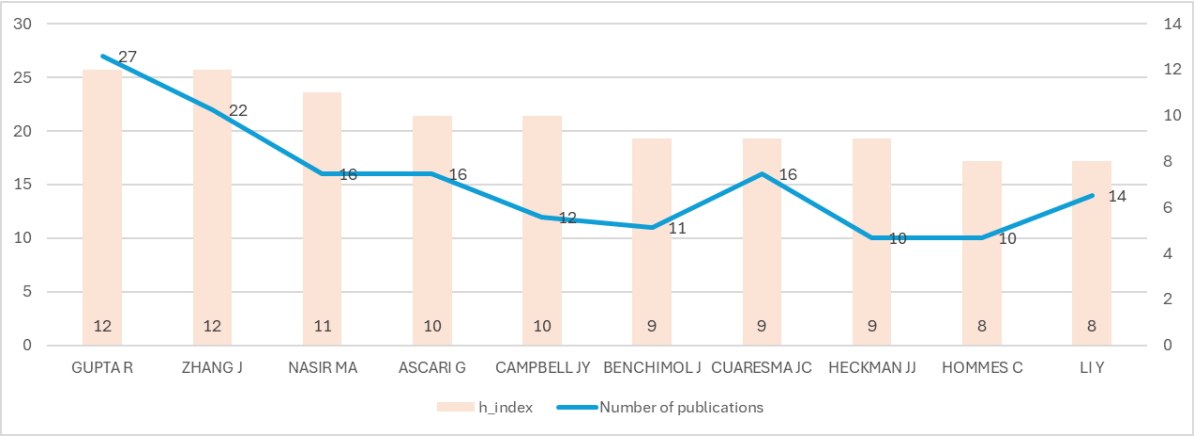

Figure 8: Relevant authors based on Hirsch index
Source: own processing

We provide a Thematic Map (see Figure 11) and a co-occurrence net (see Figure 10) to better illustrate the direction of topic development. A keyword co-occurrence network was developed to visualise the thematic structure of scholarly literature and identify key research trends. The network features clusters of keywords that frequently appear together in academic articles, illustrating their conceptual and thematic links. This analysis provides insights into the connections between macroeconomic and microeconomic research fields. Three main thematic clusters are identified: the Green Cluster on Monetary Policy and Inflation, Centred on "inflation" and related terms like "monetary policy," "interest rates," "money," "volatility," "prices," and "shocks." This cluster highlights a traditional yet active research area focused on inflation dynamics, monetary interventions, and macroeconomic stability, with dense links indicating a lively exchange of ideas on policy uncertainty, time-series models, and consumer behaviour. The centrality of " inflation " as a bridging node underscores its significance across economic research strands. The Red Cluster addresses growth, Inequality, and Economic Impact, featuring keywords such as " growth, " " impact, " "economic-growth, " " investment, " " model, " " income, " and " inequality, " emphasising factors influencing macroeconomic performance and societal effects. The co-occurrence of "policy," "returns," and "education" suggests an approach integrating empirical growth models with real-world issues like income disparity and educational outcomes. The Blue Cluster encompasses innovation, Productivity, and Performance, with terms like "performance," "productivity," "innovation," "firms," "technology," and "management," Reflecting a microeconomic perspective on how individual firms or sectors contribute to economic performance through innovation and knowledge creation. Keywords such as quality, R&D, and knowledge management are central here. Although this cluster is smaller and less interconnected, it underscores growing attention to firm-level efficiency and technological progress as key growth drivers. Notably, "inflation" links the macroeconomic stability cluster with the economic impact cluster, indicating its role as a fundamental factor influencing growth, policy effectiveness, and performance. Similarly, "impact" connects to themes of innovation and productivity, demonstrating an interdisciplinary approach that combines macroeconomic and microeconomic concerns.

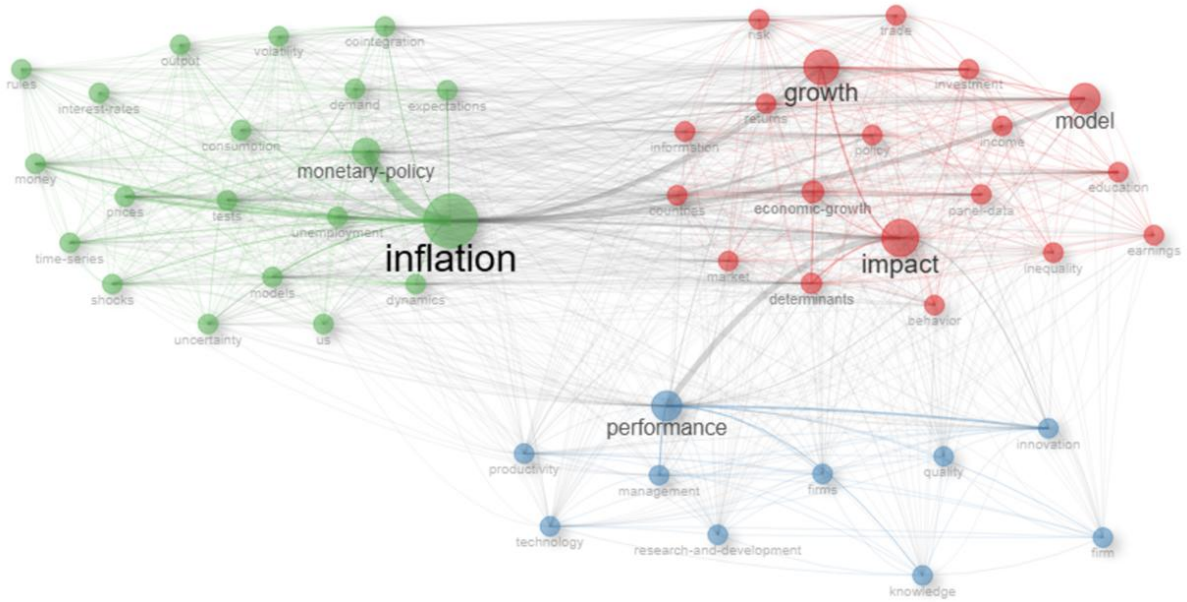

Figure 9: Co-occurrence keyword (co-word) network
Source: own processing

Thematic mapping (see Figure 11), derived from co-word analysis, offers a strategic overview of the research field's conceptual structure. Themes are positioned in a two-dimensional space based on their centrality—indicating relevance to the field—and density, reflecting their internal development level. The map is divided into four quadrants: Upper-Right (Motor Themes), which are highly central and well-developed; Upper-Left (Niche Themes), which are well-developed but isolated; Lower-Right (Basic Themes), important yet underdeveloped; and Lower-Left (Emerging or Declining Themes), which show weak development and relevance. Basic Themes represented by the keywords "growth," "model," and "economic growth" are situated within the basic themes quadrant. These terms are central to the scholarly discourse, underscoring their foundational importance. Nonetheless, their low density suggests that, despite frequent mention, these topics may lack internal coherence or specialisation. This positioning implies that they constitute the theoretical underpinnings of the domain but could benefit from further development in terms of theoretical refinement or methodological rigour. Niche Themes are represented by keywords such as "impact," "performance," and "innovation. These topics demonstrate high density, reflecting robust internal development and specialisation. However, their lower centrality indicates limited influence or connectivity within the broader research landscape. This suggests that, although these themes are well-established and self-contained, they may not be extensively integrated across other core areas of the literature. Central Themes located at the intersection of the axes is a dense, central cluster encompassing “inflation,” “monetary policy,” and “policy.” These themes exhibit high centrality and moderate density, positioning them near the middle of the thematic map. Their placement demonstrates strong integration within the literature and internal cohesion, designating them as core themes within the research domain. Additionally, their central location emphasises their significance in shaping and linking various subfields, particularly those concerned with macroeconomic stability, fiscal policy, and regulatory analysis. The upper-right quadrant (motor themes) and lower-left quadrant (emerging or declining themes) are predominantly unpopulated. This distribution suggests a research field that may lack currently dominant or rapidly evolving themes and nascent or declining focus areas. The paucity of prominent emerging themes could reflect a mature research landscape with stable core concepts or indicate future innovation and diversification opportunities.

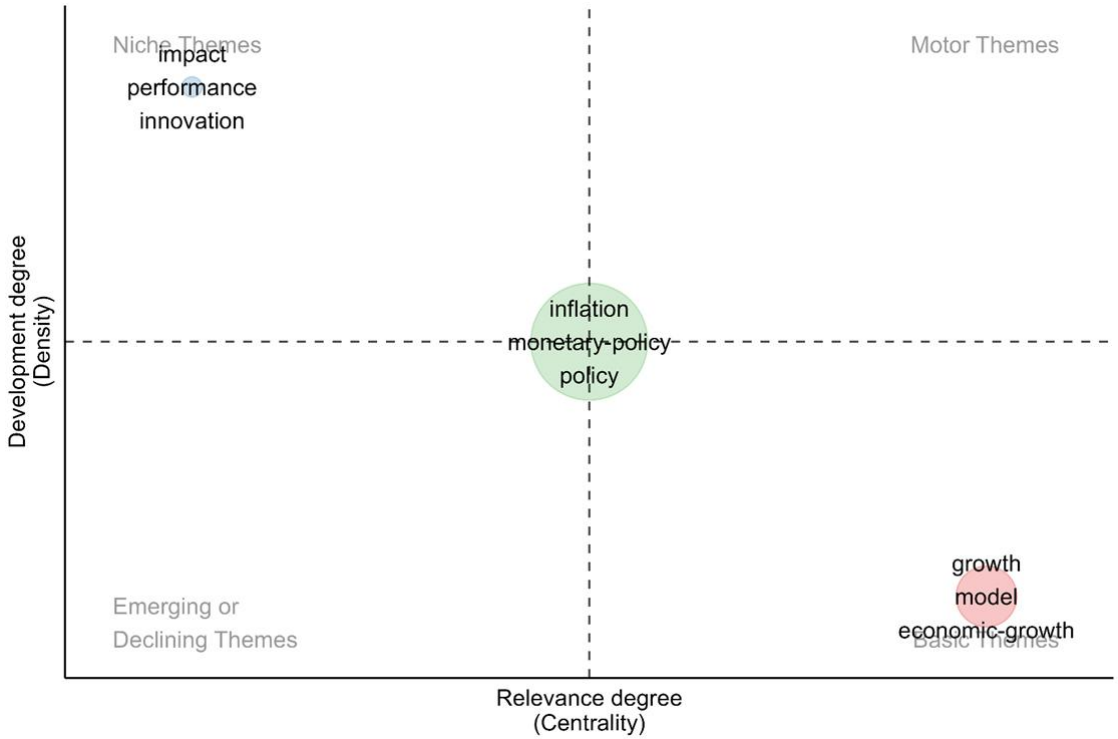

Figure 10: Thematic map
Source: own processing

The findings of the bibliometric analysis provide direct answers to the research questions. In relation to the first research question, the results confirm that inflation and monetary policy represent dominant and highly interconnected themes within the literature, forming the core of the analysed research field. Regarding the second research question, brain drain appears as a relatively peripheral topic, indicating its limited integration into the core macroeconomic discourse. Concerning the third research question, the identified thematic patterns — particularly the peripheral position of brain drain and the dominance of macroeconomic themes such as inflation and monetary policy — highlight the need for stronger integration of human capital research into public policy frameworks. This is especially relevant in areas such as talent retention, regional disparities, and institutional support for economic growth.

The findings of this study can be compared with previous bibliometric research on scientific mobility, which used publication data from Scopus and Web of Science to identify researchers' movements through changes in their geographical and institutional affiliations. Moed and Halevi (2014) demonstrated the potential of bibliometric data for tracking international scientific migration, while also emphasising the need for cautious interpretation and the use of complementary data sources. Robinson-Garcia et al. (2019) distinguished between migrants, who severed their affiliation ties with their country of origin, and mobile researchers who retained their original affiliation, while also identifying differences in their scientific impact. Subbotin and Aref (2021) subsequently showed that the international mobility of researchers cannot always be interpreted solely as brain drain, since in some cases it may be more accurately characterised as brain circulation. These studies therefore examine the actual movements of researchers as carriers of highly skilled human capital. In contrast, our analysis does not measure migration flows or affiliation changes, but examines the thematic position of brain drain as a specific form of human capital mobility within the broader macroeconomic literature. The peripheral position of brain drain in our findings therefore complements previous bibliometric research by indicating the limited integration of human capital mobility into mainstream macroeconomic research.

The relatively peripheral position of brain drain may be considered noteworthy given the growing importance of highly skilled labour mobility in knowledge-based economies. One possible explanation is the limited connection between research on brain drain and the mainstream macroeconomic literature. Brain drain and human capital mobility are often examined primarily within migration studies, development economics, labour economics, demography, or higher education research, whereas inflation and monetary policy represent traditional and methodologically well-developed areas of macroeconomic research. The dominance of inflation and monetary policy therefore does not necessarily imply that brain drain is of lesser economic importance. Rather, it may indicate that research on human capital mobility remains insufficiently integrated into mainstream macroeconomic research.

From a theoretical perspective, the peripheral position of brain drain suggests that human capital mobility remains insufficiently incorporated into mainstream macroeconomic frameworks. This points to a conceptual gap between research on human capital, migration, and macroeconomic performance. A more integrated theoretical perspective could improve our understanding of how the international mobility of highly skilled workers affects innovation and long-term economic growth.

CONCLUSIONS

This bibliometric study provides a comprehensive overview of scholarly discussions at the intersection of human capital, inflation, and economic growth, based on a large dataset of 8,759 documents authored by 17,627 researchers and published across 718 academic journals. The analysis shows that inflation and monetary policy are central, well-connected themes in macroeconomic research. In contrast, economic growth and modelling are more fundamental but less thematically linked. Additionally, topics such as performance, innovation, and impact are niche areas, reflecting specialised but less interconnected streams of research. Despite the increase in publications and international collaboration—particularly led by countries like the USA—the theme of human capital, especially regarding brain drain, remains on the periphery of core macroeconomic discourse. This gap offers an opportunity for scholars and policymakers to explore how talent migration influences both originating and receiving economies more thoroughly.

The results also provide direct answers to the research questions. First, the analysis identifies inflation and monetary policy as dominant and highly interconnected themes shaping the structure of the research field. Second, brain drain is shown to occupy a relatively peripheral position, indicating its limited integration into the core macroeconomic discourse. Third, the findings highlight important implications for public policy and economic governance, particularly in terms of talent retention, the reduction of regional disparities, and the strengthening of institutional frameworks supporting long-term economic growth.

The findings suggest that human capital may deserve greater attention in macroeconomic policy debates. In the context of developing countries, the identified research patterns point to the potential relevance of measures aimed at retaining and attracting highly skilled individuals, including support for education, innovation infrastructure, and favourable labour conditions. For developed nations, the findings also raise broader questions concerning the balance between domestic labour-market and productivity objectives and the possible consequences of attracting skilled migrants from more vulnerable regions. International collaboration—both in research and policy— may represent one possible avenue for addressing the challenges associated with global talent mobility and intellectual capital transfer. These implications should, however, be interpreted cautiously, as the present bibliometric analysis does not directly evaluate the effectiveness of specific policy measures.

Despite the extensive dataset, this study has several limitations that need to be taken into account. This study relies solely on data from the Web of Science database, which is reputable

but may not encompass all relevant literature, especially regional or non-English studies indexed elsewhere, such as Scopus, Google Scholar, or EconLit. Moreover, bibliometric analyses emphasise publication and citation patterns over content depth or causality, which can restrict insights into thematic influence and direction. Given the rapid evolution of economic terminology and interdisciplinary overlaps, it is possible that our chosen combination of search terms has not fully captured newer concepts (e.g. *talent circulation, knowledge spillovers*) that have only entered the literature in recent years. The results highlight the presence of certain themes within academic debate, yet they cannot directly determine the extent to which these insights influence economic policy or actual migration strategies of countries. The practical implications therefore remain an open question. Moreover, publication activity in low-income countries or in post-socialist economies tends to be underrepresented. This may lead to the real experiences of brain drain in these contexts being less visible in the bibliometric picture than their actual economic significance would suggest.

Future research should address the identified limitations and broaden the knowledge base in multiple directions. Besides linking bibliometric results with macroeconomic indicators, it is crucial to consider the role of public administration at regional and local levels. Municipal and regional authorities are often those directly affected by brain drain – whether through shortages of professionals in education, healthcare, and public services, or through their limited ability to retain young graduates within the region.

Future studies could therefore examine what tools local governments have available to retain talent – for example, regional programmes supporting innovation, grant schemes for young researchers, the creation of high-quality jobs, or collaboration with universities and local businesses. It is equally important to assess the extent to which municipalities can utilise the concept of "brain circulation", that is, maintaining connections with professionals who have moved abroad and attracting their expertise back through partnerships, mentoring, or digital collaboration.

Research with such a focus would advance the discussion from purely academic mapping towards a practical assessment of regional policies' effectiveness. Simultaneously, it would raise broader questions: how to ensure that regional policy remains not only reactive but also strategic in developing and maintaining intellectual capital.

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