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ORIGINAL PAPER

Macroeconomic Determinants of Bank Profitability. Research Trends and Future Perspectives in the Era of Artificial Intelligence

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Abstract:
The aim of this study is to conduct a bibliometric analysis of the scientific literature examining the relationship between macroeconomic variables and bank profitability, with the objective of identifying the main research trends, the most influential authors and the dominant thematic areas addressed in this field. Using bibliographic data extracted from the Web of Science Core Collection for the period 2010-2026 the study maps citation networks, co-authorship structures and keyword co-occurrence patterns in order to reveal the intellectual architecture of research on macroeconomic determinants of banking performance. The results highlight a significant and continuously expanding body of literature, confirming that the analysis of the impact of macroeconomic factors, such as economic growth, inflation and unemployment, on bank profitability, measured through indicators such as Return on Assets (ROA) and Return on Equity (ROE), represents a topic of sustained and growing interest among researchers. At the same time, the findings reveal a strong predominance of traditional econometric approaches and a relatively limited integration of advanced analytical methods. The main conclusions emphasize that, despite the maturity of the research field, significant gaps persist, particularly regarding the use of artificial intelligence in modeling banking performance. In this context, artificial intelligence is identified as a promising analytical framework capable of capturing complex and non-linear relationships that are often difficult to address using conventional econometric techniques. The study contributes to the literature by providing a structured overview of existing research and by outlining future directions focused on the development of hybrid models that integrate econometric and AI-based approaches to enhance both explanatory and predictive performance in the banking sector.
Keywords: *bibliometric analysis, bank profitability, macroeconomic determinants, artificial intelligence, ROA, ROE*

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Introduction

The analysis of bank profitability has become a major area of interest within financial economics, particularly against the backdrop of increasing economic volatility, the globalization of financial markets and rapid technological transformations. Understanding the factors that determine the performance of the banking sector is essential for both financial institutions and policymakers, given the fundamental role of banks in financial intermediation, supporting economic growth and maintaining financial stability. Events in recent decades, such as the global financial crisis, the COVID-19 pandemic and changes in the macroeconomic environment, have further emphasized the need to analyze how external economic conditions influence the profitability of banking institutions.

Within this context, macroeconomic variables such as economic growth, inflation rate and unemployment rate have been widely recognized as key determinants of banking performance. These factors affect credit demand, risk exposure, cost structures and overall financial stability, thereby influencing core profitability indicators such as Return on Assets (ROA) and Return on Equity (ROE). At the same time, the increasing availability of large datasets and the rapid development of digital technologies have stimulated growing interest in more advanced approaches for modeling banking performance.

In particular, recent advancements in artificial intelligence have opened new perspectives for financial analysis, enabling the identification of complex, non-linear relationships and improving the accuracy of predictive models. Despite this potential, the integration of artificial intelligence into research on bank profitability remains relatively limited, reflecting a methodological concentration around econometric frameworks.

The motivation of this study lies in the need to provide a comprehensive and systematic overview of the academic literature addressing the relationship between macroeconomic variables and bank profitability, while also examining the extent to which emerging technologies, particularly artificial intelligence, are being incorporated into this field. Understanding these dynamics is essential for identifying both the strengths and limitations of current research approaches.

The main objective of this paper is to conduct a bibliometric analysis of the scientific literature in order to identify the most influential publications, key authors, dominant research themes and methodological approaches in the study of macroeconomic determinants of bank profitability. Additionally, the study aims to highlight emerging research trends and to assess the extent to which artificial intelligence is being integrated into this field.

Although artificial intelligence is not explicitly included in the search strategy, this paper adopts a forward-looking perspective by examining how AI-based methods are gradually entering the field. Consequently, the contribution related to artificial intelligence is primarily conceptual and prospective, focusing on the identification of emerging research directions rather than on a systematic empirical assessment of AI applications in banking performance analysis.

The novelty of the research lies in the combined use of bibliometric techniques and a forward-looking perspective, which provides a clearer understanding of current research trends and identifies significant gaps, particularly the limited adoption of AI-based methods in analyzing banking performance.

The paper is structured as follows: it begins with an introduction, followed by the literature review and the methodological framework. The results section presents the main findings, while the final section summarizes the conclusions and outlines future research directions, including the role of artificial intelligence in banking performance analysis.

Literature review

Recent bibliometric studies reveal a substantial and growing academic interest in banking performance, emphasizing the importance of macroeconomic and bank-specific determinants, while also pointing to the increasing need for integrating advanced analytical approaches, such as artificial intelligence, in this research field.

Mirović, Kalaš, Milenković, Andrašić & Đaković (2024) examine the determinants of bank profitability in the Eurozone, highlighting the joint influence of bank-specific and macroeconomic factors. Their findings indicate that internal variables such as non-performing loans and the cost-to-income ratio negatively affect profitability (ROA, ROE), while income diversification supports bank performance. Among macroeconomic determinants, GDP growth exerts a positive impact, whereas inflation, unemployment and public debt negatively influence profitability. Overall, the study underscores the importance of macroeconomic stability for the sustainability and profitability of the banking sector.

Similar findings are reported by Uddin & Hossain (2024), who analyze bank profitability in an emerging economy. Their results confirm that both bank-specific characteristics, such as capital adequacy, operational efficiency and asset quality, and macroeconomic conditions significantly influence performance. In particular, economic growth has a positive effect, while inflation and interest rate fluctuations shape the income structures of the bank and financial stability.

Another empirical evidence shows that GDP supports bank profitability, while unemployment increases credit risk and negatively affects performance. Inflation exhibits mixed effects, supporting profitability at moderate levels but contributing to instability when excessive. Overall, these findings highlight the essential role of macroeconomic stability in sustaining banking sector profitability in emerging European economies (Kalaš, Andrašić, Milenković & Mirović, 2021).

Extending this perspective, Khan (2022) finds that economic growth remains a significant driver of profitability in GCC countries, whereas inflation has a limited or statistically insignificant effect. The study also emphasizes the stronger influence of bank-specific factors, particularly asset management efficiency.

Consistent with these findings, Rai, Mohapatra, Meitei & Jain (2023) confirm the dominant role of internal determinants such as efficiency, asset quality and capital adequacy, while macroeconomic variables exert a more moderate influence. Importantly, their results show that machine learning models outperform traditional econometric approaches by capturing complex interactions and non-linear relationships.

In the same time, a recent study highlights the transformative role of emerging technologies, particularly artificial intelligence, in improving the evaluation of the impact of macroeconomic factors on banking performance. Advanced analytical tools, including AI-based models, enable more accurate and timely assessment of the relationship between economic variables and financial outcomes, enhancing risk analysis and forecasting capabilities. In this context, the integration of artificial intelligence represents a strategic direction for the banking sector, supporting more efficient decision-

making processes and contributing to improved profitability and resilience (Popescu & Spulbar, 2025).

Research Methodology

The present paper conducts a bibliometric methodology that involves the use of a quantitative approach to examine scientific literature by focusing on its external characteristics. Recent studies emphasize the growing relevance of bibliometric methods in financial research, as they provide a systematic framework for identifying key research trends, thematic structures and emerging directions within complex scientific domains (Spulbar & Fulga, 2025).

For the purposes of this study, the bibliometric analysis was conducted using VOSviewer, a widely used software tool designed for constructing and visualizing bibliometric networks through various techniques such as co-authorship analysis, co-citation analysis and keyword co-occurrence analysis. These techniques facilitate the identification of the intellectual structure of a research field as well as the detection of the main thematic clusters emerging within the scientific literature.

The Web of Science Core Collection database was used as the primary source for data collection in this study. This database was selected due to its extensive coverage of high-quality academic publications, which ensures access to a broad and relevant set of studies addressing the determinants of banking performance and profitability.

The search strategy was designed to identify publications examining the relationship between bank profitability and macroeconomic variables. The search was conducted using the Topic Search (TS) function in the Web of Science Advanced Search interface, which retrieves terms appearing in article titles, abstracts and keywords.

Table 1. Research strategy

Search filters	Details
Database	Web of Science Core Collection
The analyzed period	2010-2026
Keywords used in the search	("bank*") AND ("profitability" OR "ROA" OR "ROE" OR ”Return on Assets” OR ”Return on Equity”) AND ("GDP growth" OR "economic growth" OR "inflation" OR "unemployment" OR ”macroeconomic”)
Language	English
Document type	All type of the documents
Research areas	First 10 research areas
Sample size	1175
Tools used for analysis	Excel and VOSviewer

Source: Authors contribution based on data provided by Web of Science

To ensure the relevance and consistency of the bibliometric analysis, only publications indexed in the WoScience database were considered. The search was conducted for the period 2010-2026 and the analysis was limited to the top ten Web of Science research areas most closely related to the research topic, in order to comprehensively capture the evolution of scientific research addressing the relationship between macroeconomic variables and bank profitability. These research areas were

determined based on the total number of publications identified after applying the filtering criteria described in the following section.

The search strategy included specific terms and combinations of keywords relevant to the research topic, such as: ("bank*") AND ("profitability" OR "ROA" OR "ROE" OR ”Return on Assets” OR ”Return on Equity”) AND ("GDP growth" OR "economic growth" OR "inflation" OR "unemployment" OR ”macroeconomic”).

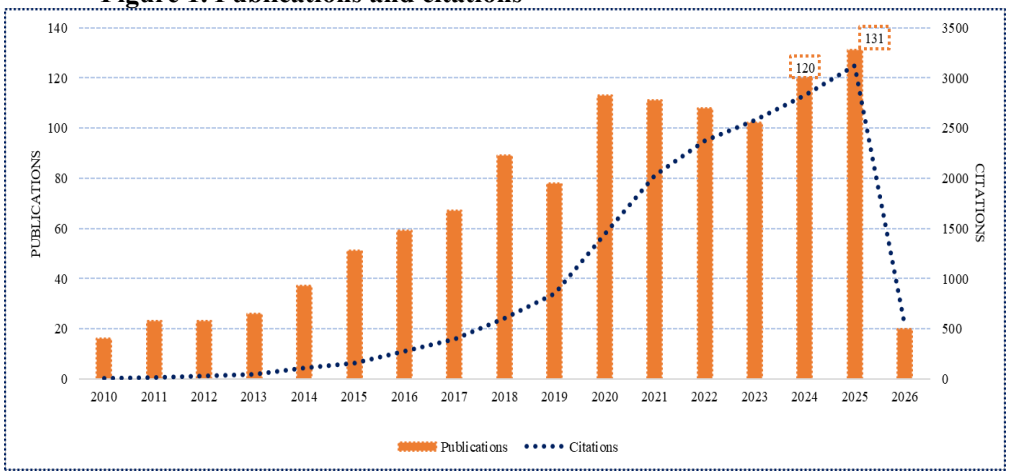
It is important to note that the bibliometric search does not use explicit AI-related keywords. Therefore, the discussion on artificial intelligence reflects a forward-looking assessment based on recent contributions and conceptual developments rather than a comprehensive mapping of all AI applications in this field.

Following the application of these filters, 1253 relevant publications indexed in the Web of Science database were initially identified. For reasons of consistency and international comparability, only documents written in English were retained in the final dataset. After applying this filter and restricting the results to the top ten research areas, the final dataset consisted of 1175 scientific publications.

Annual Distribution of Scientific Publications

Research on the relationship between macroeconomic variables and bank profitability exhibits a clear upward trend in publications and citations. As shown in Figure 1, this pattern can be divided into three distinct phases, reflecting both the evolution of the literature and broader economic and financial transformations in the banking sector.

Figure 1. Publications and citations



Source: Authors contribution based on data provided by Web of Science

The selection of the 2010-2026 period aims to capture the progressive development of academic research examining the relationship between macroeconomic variables and bank profitability, with particular attention to how macroeconomic conditions influence key financial performance indicators such as Return on Assets (ROA) and Return on Equity (ROE).

The first stage (2010-2014) is characterized by a relatively modest level of scientific production. During this period, the annual number of publications remains

below 40 articles, increasing gradually from 16 publications in 2010 to 37 publications in 2014. The relatively limited number of studies suggests that research on the macroeconomic determinants of bank profitability was still developing, with most analyses focusing primarily on traditional bank-specific determinants rather than broader macro-financial interactions.

The second stage (2015-2019) reflects a period of steady growth in academic output. The number of publications increased significantly, rising from 51 articles in 2015 to 89 articles in 2018, although a slight decline can be observed in 2019 (78 publications). This growth coincides with the increasing availability of international banking datasets and the growing interest in empirical studies investigating how macroeconomic indicators such as GDP growth, inflation and unemployment affect banking sector performance. During this stage, the citation trend also begins to accelerate, indicating a growing recognition of the importance of this research area within the academic community.

The third stage (2020-2025) represents a period of accelerated expansion and consolidation of scientific interest in this research field. The number of publications surpasses 100 articles per year, reaching 113 publications in 2020 and maintaining a consistently high level in subsequent years. The peak is recorded in 2025, with 131 publications, highlighting the growing academic attention dedicated to the study of banking sector performance under changing macroeconomic conditions. The citation trend follows a similar trajectory, increasing rapidly and reaching its highest level in 2025.

For 2026, the data presented in the figure reflect the partial situation at the time of data collection. The relatively low number of publications and citations observed for this year should therefore not be interpreted as a decline in scientific interest, but rather as a consequence of the fact that the current year has not yet been completed and that the publication and citation processes are still ongoing.

Overall, the graphical representation confirms a sustained upward trajectory in the academic literature addressing macroeconomic determinants of bank profitability, indicating that this topic has become an increasingly important research direction within the broader field of banking and financial economics. This dynamic can be explained by the fact that research intensity and thematic focus are often influenced by periods of financial and economic instability, which reshape the relevance of specific risk factors and stimulate academic interest in analyzing their impact on banking performance (Spulbar & Cinciulescu, 2025).

Results and Discussion

The analysis of the most cited articles published in the last five years provides insights into the main research directions and methodological approaches in the field. The evidence shows that bank profitability is shaped by both macroeconomic conditions and internal characteristics, with economic growth exerting a positive influence, while inflation and other indicators display more heterogeneous effects.

Among the most cited studies in recent years, particular attention is given to research highlighting the growing role of emerging technologies, particularly artificial intelligence, in improving banking performance. In this context, the study by Gyau, Appiah, Gyamfi, Achie & Naeem (2024) shows that AI-driven innovation has a significant positive impact on bank profitability, supported by economic growth and the development of digital infrastructure. The findings emphasize that the integration of

artificial intelligence not only enhances financial performance but also improves decision-making processes in the banking sector.

Other relevant studies provide complementary perspectives on the determinants of banking performance. The study by Klein & Weill (2022) demonstrates that bank profitability positively influences economic growth in both the short and long term, reinforcing the role of the banking sector in supporting economic development. Similarly, the research by Isayas (2022) confirms that macroeconomic variables, particularly GDP growth, have a significant impact on bank profitability, alongside internal factors such as capitalization and liquidity.

In the European context, the analysis by Grzeta, Zikovic & Zikovic (2023) underlines the importance of bank size and regulatory frameworks in determining banking performance. The results indicate that Basel III regulations have differentiated effects depending on bank size, benefiting large and medium-sized institutions while negatively affecting smaller banks due to higher compliance costs. These findings highlight the combined influence of macroeconomic and institutional factors on bank profitability.

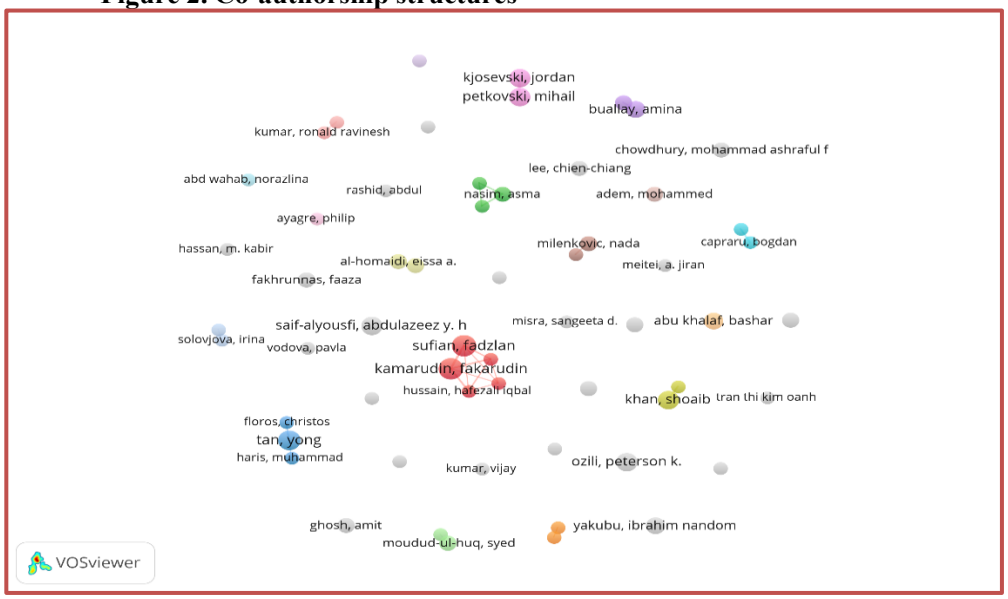
Additional evidence links banking performance to financial stability and risk dynamics. Erdas & Ezanoglu (2022) find that macroeconomic conditions and profitability influence non-performing loans, underlining the importance of sound risk management and capital structures.

Overall, the literature suggests that bank profitability is driven by a complex interaction of macroeconomic, internal and institutional factors, while recent developments indicate a gradual shift toward integrating artificial intelligence and advanced analytical approaches in the study of banking performance.

In order to systematically examine these developments and uncover the structure of the research field, the following section analyzes the bibliometric maps generated using VOSviewer.

The co-authorship analysis (Figure 2), based on a minimum threshold of three documents per author, resulted in a network of 59 authors organized into 41 clusters, with only 25 links and a total link strength of 57. The visualization reveals a highly fragmented collaboration structure, characterized by a large number of isolated authors and very small research groups.

Figure 2. Co-authorship structures

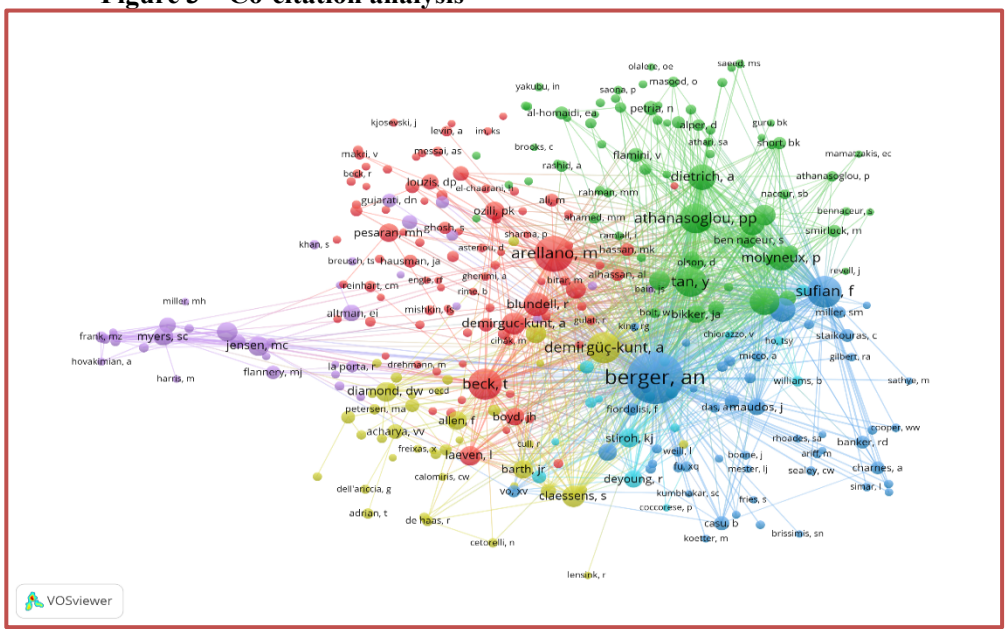


Source: Author contribution using VOSviewer, based on data extracted from Web of Science

The largest connected component consists of only five authors, indicating the absence of strong, cohesive research networks. While a few small clusters can be identified, such as collaborations among Sufian, Kamarudin and Hussain, or Tan and Haris, these groups remain limited in size and weakly interconnected. The findings suggest that, despite the maturity of the research field as evidenced by co-citation patterns, academic collaboration in the study of bank profitability remains limited and geographically dispersed. This fragmentation may hinder the development of interdisciplinary approaches and slow the adoption of innovative methodologies, including artificial intelligence-based techniques, in banking research.

The co-citation analysis of cited authors (Figure 3), based on a minimum threshold of 20 citations, resulted in a network comprising 311 authors grouped into six distinct clusters, reflecting the intellectual structure of the field. The most influential authors include Berger, Demirgüç-Kunt, Arellano, Beck, Athanasoglou, Dietrich and Sufian, whose works form the theoretical and methodological foundation of research on bank profitability. The identified clusters reveal several major research streams. One cluster focuses on banking efficiency and market structure, emphasizing the role of competition and operational performance. Another cluster is centered on econometric methodologies, particularly panel data and generalized method of moments (GMM) approaches, highlighting the dominance of quantitative techniques in the literature. A third cluster captures macroeconomic and financial development perspectives, examining the impact of economic growth and macroeconomic variables on banking performance. Additional clusters address financial stability, corporate governance and emerging market banking systems.

Figure 3 – Co-citation analysis



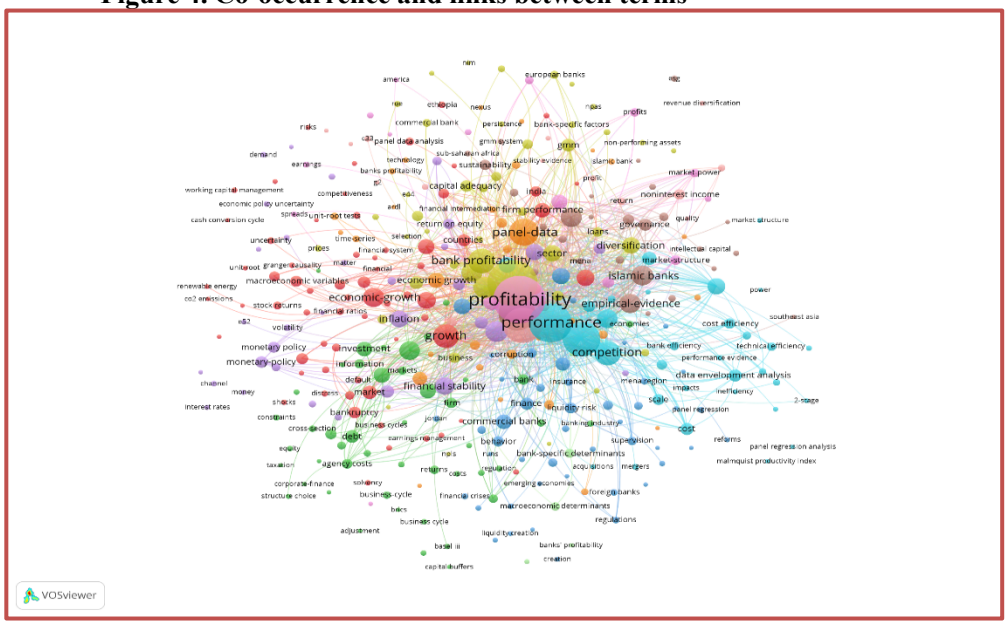
Source: Author contribution using VOSviewer, based on data extracted from Web of Science

Overall, the co-citation structure indicates a well-established and interconnected research field, primarily grounded in traditional econometric frameworks, while the limited presence of artificial intelligence-related contributions suggests potential for future research in this direction.

While the co-authorship analysis provides insights into collaboration patterns among researchers, the next map (Figure 4) offers a complementary perspective by revealing the main thematic directions of the field.

The co-occurrence analysis of keywords, based on a minimum threshold of five occurrences, resulted in a network of 363 relevant terms, highlighting the conceptual structure of the research framework. The visualization reveals that the most frequently occurring and strongly connected keywords are *profitability*, *performance*, *bank profitability* and *panel data*, indicating a strong focus on empirical investigations of banking sector performance. Several thematic clusters can be identified. The first cluster groups macroeconomic variables such as economic growth, inflation and monetary policy, emphasizing the role of external economic conditions in shaping bank profitability. A second cluster focuses on efficiency and competition, incorporating terms such as data envelopment analysis and cost efficiency, reflecting interest in operational performance. Another cluster captures financial stability and risk-related topics, including liquidity, capital adequacy and banking crises.

Figure 4. Co-occurrence and links between terms



Source: Author contribution using VOSviewer, based on data extracted from Web of Science

Additionally, methodological approaches such as panel data and GMM are prominently represented, confirming the dominance of econometric techniques in the literature. Notably, the limited presence of artificial intelligence-related terms suggests that, despite the maturity of the field, there remains significant potential for integrating advanced analytical methods into the study of bank profitability.

Conclusions

The results of the bibliometric analysis reveal a well-developed and rapidly expanding research field, characterized by increasing scientific output, strong theoretical foundations and a clear dominance of quantitative empirical approaches. Despite this maturity, the literature exhibits several important limitations, particularly a methodological focus that remains centered on econometric frameworks, alongside a limited degree of interdisciplinary integration. The findings confirm that bank-specific factors often play a dominant role, suggesting that profitability is determined by a complex interaction between internal and external variables. In this context, the integration of artificial intelligence emerges as a promising direction for future research.

A key contribution of this study is the identification of a significant gap in the literature regarding the integration of artificial intelligence techniques in the analysis of banking performance. While recent contributions demonstrate the potential of machine learning techniques to improve predictive accuracy and capture complex relationships, their adoption remains relatively low compared to traditional approaches.

In this context, the study emphasizes the need for future research to focus on integrating artificial intelligence with macro-financial analysis, through the development of hybrid models that combine econometric approaches with advanced computational techniques. Such integration has the potential to enhance the understanding of bank

profitability dynamics and to support more effective decision-making in an increasingly complex and technology-driven financial environment.

This study is subject to several limitations that should be acknowledged. First, the analysis relies exclusively on the Web of Science Core Collection and includes only publications written in English, which may bias the representation of research conducted in other languages or indexed in alternative databases. Second, the focus on the top ten research areas, while ensuring thematic consistency, might omit relevant contributions located at the margins of the field or in interdisciplinary outlets. Third, the search strategy does not explicitly incorporate artificial intelligence-related keywords, which implies that AI applications in banking performance may be underrepresented in the dataset. These limitations suggest that future research could extend the analysis to additional databases, languages and search strategies and could design a targeted bibliometric study solely focused on AI-based approaches to bank profitability.

This paper adds to the literature in several ways. First, it provides a comprehensive bibliometric mapping of 2010-2026 research on the macroeconomic determinants of bank profitability, highlighting the main intellectual clusters and most influential authors and publications. Second, it documents the dominance of traditional econometric approaches and the relative marginal position of artificial intelligence-based methods in this field. Third, it identifies the main thematic streams and conceptual linkages between macroeconomic variables, bank-specific factors and financial stability concerns. Fourth, it outlines a forward-looking research agenda by arguing for the development of hybrid econometric and AI-based models to better capture complex, non-linear dynamics in banking performance.

Authors' Contributions:

The authors contributed equally to this work.

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