Artificial Intelligence and Financial Regulation Issues

Mimma Maripatul Uula[1]
[1]*SMART Indonesia*

This study aims to see the development of research on the topic of "AI and Financial Regulation" and research plans that can be carried out based on journals published on the theme. This research uses a qualitative method with a bibliometric analysis approach. The data used is secondary data with the theme "AI and Financial Regulation" which comes from the Dimension database with a total of 90 journal articles. Then, the data is processed and analyzed using the VosViewer application with the aim of knowing the bibliometric map of "AI and Financial Regulation" research development in the world. The results of the study found that in bibliometric author mapping the authors who published the most research on the theme "AI and Financial Regulation" were Khan S; Treleaven P.; Chaquet-Ulldemolins J.; and Trakman L. Furthermore, based on bibliometric keyword mapping, there are 3 clusters with the most used words are system, model, fintech, application, innovation, analysis, industry, impact, risk, bank, and impact. Then, the research path topics related to AI and Financial Regulation are The use of AI in financial regulatory oversight, The influence of AI on financial regulation, and Financial AI regulatory compliance and Covid-19 pandemic.

Keywords: AI and Financial Regulation; Research Map; Bibliometric

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*Correspondence:
Mimma Maripatul Uula
mimma.uula@gmail.com

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INTRODUCTION

Artificial Intelligence can be defined as "a technical and scientific field devoted to engineering systems that produce outputs such as content, forecasts, recommendations, or decisions for a set of human-defined goals" (International Organization for Standardization, n.d.). This definition emphasizes the engineering nature of AI systems and their ability to operate within defined parameters to achieve specified goals. The early history of AI is often attributed to the Dartmouth Conference in 1956, where luminaries such as John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon gathered to discuss the potential of machines to mimic human intelligence. This event marked the beginning of AI as a distinct field of study. Early initiatives focused on symbolic reasoning and problem-solving techniques, with programs such as Logic Theorist and General Problem Solver laying the foundational concepts for future AI systems (Haenlein & Kaplan, 2019; Grzybowski et al., 2024).

Today, AI continues to evolve rapidly with advances in deep learning and big data analysis. These technologies enable AI systems to process large amounts of information efficiently, leading to breakthroughs in various domains including autonomous vehicles, natural language processing, and robotics. The integration of AI into everyday applications is expected to increase, raising important discussions about ethics, data privacy, and algorithmic transparency (Haenlein & Kaplan, 2019; Jean, 2020; Grzybowski et al., 2024). One aspect that is also evolving with AI and continues to discuss data privacy, ethics, and transparency is finance.

The integration of Artificial Intelligence (AI) into the financial sector has transformed various aspects of financial services, improving efficiency, accuracy and customer experience. This relationship is multifaceted, affecting areas such as supply chain finance, credit scoring, and customer service in FinTech. AI plays an important role in optimizing supply chain finance (SCF). Research shows that AI technology can address uncertainty in global financing by improving the efficiency of financial services in the supply chain. The application of AI in SCF has been associated with increased economic opportunities and better utilization of supply networks, especially after economic disruptions such as the 2008 financial crisis and the COVID-19 pandemic (Olan et al., 2022). In addition, the development of AI finance significantly reduces financing constraints, especially benefiting smaller and more innovative firms (Shao et al., 2021). This suggests that AI can democratize access to financial resources, encouraging entrepreneurship and innovation.

Furthermore, AI can utilize structured financial data and unstructured nonfinancial data to create more inclusive credit models, thereby improving access to finance for underserved SMEs (Rybakovas & Žigienė, 2021). This dual approach not only broadens the scope of credit assessment but also enables lenders to make more informed decisions. On the other hand, in FinTech, AI has revolutionized customer experience by personalizing services and improving service quality. A study focusing on customer perceptions of AI-based FinTech services identified key factors that influence user satisfaction, such as perceived usefulness and service quality. These factors are critical to increasing customer engagement and loyalty in an increasingly competitive market (Arora et al., 2023).

However, the integration of the financial system with AI also presents significant challenges that require regulatory oversight. AI systems rely heavily on large amounts of data, which raises concerns about data management, privacy and security. The complexity and opaqueness of AI models can lead to difficulties in understanding how decisions are made, often referred to as the "Black Box" problem. This lack of transparency can obscure biases in the decision-making process, potentially leading to discriminatory practices in areas such as credit underwriting and lending (Brousse et al., 2024; Buckley et al., 2021). Regulators increasingly recognize that without proper oversight, these biases can become systemic, undermining consumer confidence and financial stability (IOA Global, n.d.; London School of Economics, 2024).

In addition, the application of AI in finance may exacerbate existing financial stability risks. For example, AI-driven trading systems can amplify market volatility due to their reliance on the same data inputs across multiple institutions, which creates interconnected vulnerabilities (London School of Economics, 2024). The Financial Stability Board has recognized that AI's influence on trading could lead to unpredictable market behavior, necessitating new regulatory measures such as resilience tests and adjustments to capital requirements to ensure that institutions can withstand potential shocks (Brousse et al., 2024; London School of Economics, 2024). Ethical issues surrounding AI applications are also very important, particularly those concerning consumer protection and fairness. The use of AI in financial

services can lead to biased results if the underlying data reflects historical inequalities or if the algorithms are not designed with fairness in mind. The EU AI Act addresses these ethical concerns by imposing strict requirements on high-risk AI applications, emphasizing the need for transparency and accountability in their application.

Therefore, the emergence of AI technologies demands a re-evaluation of the existing regulatory framework. Current regulations may not adequately address the unique challenges posed by AI, leading to calls for specialized approaches that incorporate human oversight into AI governance. Proposed solutions include the establishment of internal governance mechanisms such as AI due diligence processes, explanation requirements, and review committees to ensure the responsible use of AI within financial institutions (Buckley et al., 2021; Ellex, n.d.). Therefore, it is important to see the extent of the current development of *AI and Financial Regulation* through research, and one method that can be used to see the development of research is bibliometrics using VosViewer. The method is able to create and display author journal maps and research paths based on co-citation data or keyword maps based on co-incidence data.

Some of the research that examines *AI and Financial Regulation* is Buckley et al (2021) developed a framework for understanding and addressing the increasing role of artificial intelligence ('AI') in finance. This research focuses on human responsibility as central to addressing AI "black box" issues - that is, the risk of AI producing unintended outcomes that are not recognized or not anticipated due to people's difficulty in understanding the internal workings of AI or as a result of AI's independent operations outside of human supervision or involvement. This research highlights a range of potential issues and regulatory challenges related to AI financial services and the tools available to address them. The most effective regulatory approach to addressing AI's role in finance involves humans through a personal liability regime, thus eliminating the black box argument as a defense against legal responsibility and liability for AI operations and decisions.

Pattnaik et al (2024) examined the status of artificial intelligence (AI) research and machine learning (ML) applications in the Banking, Financial Services and Insurance (BFSI) sector. The results of this study explain that based on N-gram analysis identified 177 unique terms in article titles and abstracts. Co-occurrence analysis revealed nine distinct clusters covering fintech, risk management, anti-money laundering, and actuarial science, among others. The clusters offer a comprehensive overview of the multifaceted research landscape. Ahmed et al (2022) reviewed the artificial intelligence (AI) and machine learning (ML) literature in finance. The research revealed an upward trajectory in publication trends starting from 2015 and found applications of AI and ML in bankruptcy prediction, stock price prediction, portfolio management, oil price prediction, anti-money laundering, behavioral finance, big data analysis, and blockchain. In addition, the United States, China, and the United Kingdom are the top three contributors to the literature.

Kanaparthi (2024) explored the intellectual basis of AI and ML in finance research. The research identifies influential works, important contributions, thought leaders, topic clusters, research streams, and new research frontiers, ultimately driving a deeper understanding of the knowledge structure in AI and ML financial research by considering publication records from 2010 to 2022 from multiple search engines and database sources. The research also found a marked increase in publications from 2017 to 2022, which highlights the growing interest and expansion of research activities in the field, indicating its potential significance and relevance in the contemporary academic landscape.

Goodell et al (2021) identified the foundations, themes, and research clusters of bibliometric analysis related to Artificial intelligence and machine learning in finance. This study summarizes the thematic structure of AI and ML research in finance for 1986-April 2021. By uncovering nine (co-citation) and eight (bibliometric coupling) specific finance clusters that apply AI and ML, there are then three overarching clusters of finance studies that are roughly equivalent for both forms of analysis, namely portfolio construction, valuation, and investor behavior, financial fraud and distress, and sentiment inference, forecasting, and planning. Bahoo et al (2024) discussed Artificial Intelligence in finance. The results found that the literature on the topic has grown rapidly since the beginning of the 21st century, covering different countries and different applications of AI in finance, among which Predictive/forecasting systems, Classification/detection/early warning systems and Big data analysis/Data mining/Text mining are prominent. Furthermore, the study also shows that the selected articles fall into ten major research streams, where AI is applied to stock markets, trading models,

volatility forecasting, portfolio management, performance, risk and default evaluation, cryptocurrencies, derivatives, credit risk in banks, investor sentiment analysis, and foreign exchange management.

Elouidani & Outouzzalt (2022) investigated the role of artificial intelligence techniques in supporting sustainable finance, to assess its progress, and to shed light on research trends over the past decade using bibliometric analysis. The results showed that, despite a significant increase in the number of publications since 2017, author collaboration was minimal, especially at the international level. Furthermore, the research findings also provide an overview of the interdisciplinary study of the topic. Artificial intelligence approaches are widely used as viable substitutes for traditional methods, with promising results. Nahar et al (2024) identified and systematically analyzed the underlying theories, emerging themes, and research clusters in the Artificial Intelligence (AI) and Machine Learning (ML) finance literature. The research reveals the complex evolution of AI and ML applications in finance, mapping out key areas of research and providing valuable insights into future research directions. The research also reveals significant and accelerating growth in the application of AI and ML across various financial domains, particularly in fraud detection, portfolio management, and algorithmic trading, demonstrating the substantial impact and transformative potential of these technologies.

This research was conducted to complement existing research and fill the gaps of previous research and to expand the literature related to *AI and Financial Regulation* through the research path. In particular, the purpose of this research is to see the development of "*AI and Financial Regulation*" research published by journals with this theme and see future research opportunities by formulating a research agenda.

METHOD

In this research, various scientific journal publications related to the theme of "*AI and Financial Regulation*" around the world are used as data sources. Data is collected by searching for journal publications indexed in the Dimension database using the keywords "*AI and Financial Regulation*". After that, scientific articles or journals that are relevant to the research theme will be selected based on the publication data that has been collected. Journals equipped with DOI are the criteria in the filtering process and data processing using software. There were 432 journal articles published under the research theme "*AI and Financial Regulation*". The development of publication trends related to the research topic was analyzed using VOSviewer software, which can generate bibliometric maps and allow for more detailed analysis.

In order to build the map, VOSviewer uses the abbreviation VOS which refers to Visualizing Similarity. In previous studies, the VOS mapping technique has been used to obtain bibliometric visualizations which are then analyzed. Furthermore, VOSviewer is able to create and display author journal maps based on co-citation data or keyword maps based on co-incidence data. Therefore, this study will analyze journal maps related to "*AI and Financial Regulation*", including author maps, and keywords which are then analyzed for research paths that can be carried out in the future through clusters in *keyword mapping*.

This research uses a descriptive qualitative approach with meta-analysis and descriptive statistical literature study based on 432 journal publications that discuss the theme of "*AI and Financial Regulation*". Meta-analysis is a method that integrates previous research related to a particular topic to evaluate the results of existing studies. Furthermore, the qualitative method used in this research is also referred to as a constructive method, where the data collected in the research process will be constructed into a more understandable and meaningful theme. The sampling technique used in this research is purposive non-probability sampling method, which aims to fulfill certain information in accordance with the desired research objectives. Studies using bibliometric analysis in research on other economic and financial topics can be seen in Napitupulu, et al., (2024); Ozdemir & Selçuk (2021), Rusydiana (2021), Mi'raj & Ulev (2024), Rusydiana et al., (2023), and also Khalifah et al., (2024).

RESULT AND DISCUSSION

This research discusses "*AI and financial regulation*" by utilizing 432 publications of journal articles indexed in Dimension. Bibliometrics is a method used to measure and evaluate scientific performance by taking into account factors such as citations, patents, publications, and other more complex indicators. Bibliometric analysis is conducted to evaluate research activities, laboratories, and scientists, as well as the performance of countries and scientific specializations. Some of the steps in bibliometric analysis include identifying the background of the research, collecting the databases to be used, and

determining the main indicators to be used in the research.

This section will deepen the meta-analysis results by showing a visual mapping chart depicting 432 journals related to "*AI and financial regulation*". In this study, mapping is done by analyzing keywords and important or unique terms contained in journal articles. Mapping is a process to identify knowledge elements, configurations, dynamics, dependencies, and interactions among these elements. The results of the network visualization of 432 journals with the theme "*AI and financial regulation*" will be explained in more detail in the next section.

Bibliometric Author Mapping

Using bibliometric analysis using VOSviewer software, a mapping of authors contributing to the field of "*AI and financial regulation*" was obtained. The resulting image provides a visual representation of the mapping, the larger and brighter the point marked in yellow, the greater the number of journal publications related to the theme of "*AI and financial regulation*" that have been published by that author.

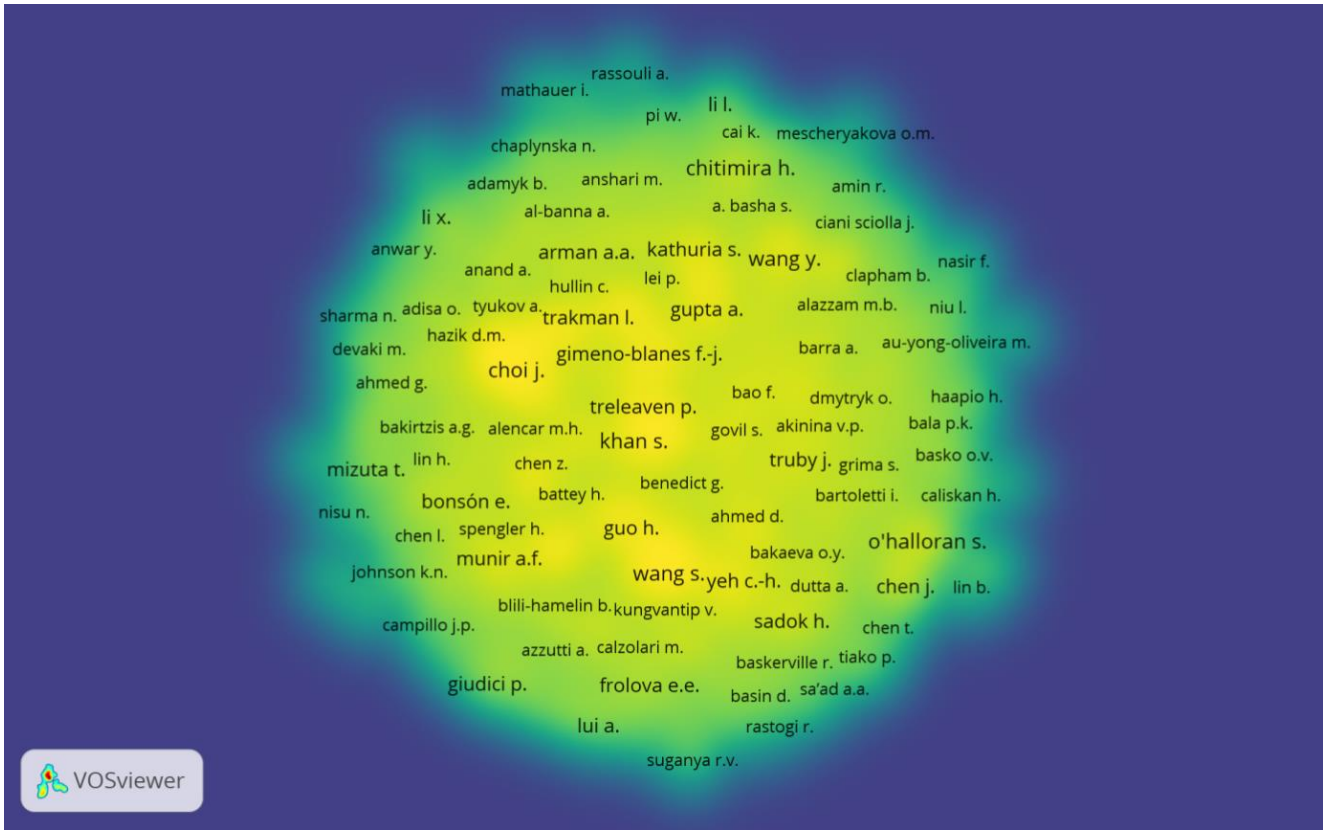

Figure 1. Author map

The figure above explains that the cluster density in the bibliometric map depends on the intensity of the yellow color shown. And the yellow color on the map depends on how many items are related to other items. For this reason, this section is very important to get an overview of the general structure of the bibliometric map that is considered important to analyze. From this, it is possible to identify the authors who publish the most works.

In general, each author or researcher has different tendencies in each publication of their work. On some occasions, an author appears as a single author, but on other occasions the author may co-author with other authors or researchers, so this will affect the cluster density and some clusters show different densities. However, authors who have a large enough cluster density identify that the author has published the most research on the theme of "*AI and financial regulation*", when compared to authors with lower cluster density, so the results found can be a reference for other researchers in the future. From the analysis, the authors who published the most publications related to "*AI and financial regulation*" include Khan S; Treleaven P.; Chaquet-Ulldemolins J.; Trakman L; Gupta A.; Arman A.A; Kathuria S.; Wang Y; Chitimira H.; Kumar A; Li L; Li X; Choi J; Truby J; Mizuta T; Guo H; Bonsón E.; O'halloran S.; Munir A.F; Wang S; Sadok H; Yang C.Y.; Frolova E.E.; Chen J; Giudici P.; and Lui A.

Research Map

The figure below describes the trend of keywords appearing in research on the theme of "*AI and financial regulation*" and the larger shapes are the most used words in journal publications on the theme of "*AI and financial regulation*".

Figure 2. Research map

As for the mapping, the keywords that appear most in the publication "*AI and financial regulation*" include system, model, fintech, application, innovation, analysis, industry, impact, risk, bank, and impact which are then divided into 3 clusters, as follows:

Cluster 1: The use of AI in financial regulatory oversight

This cluster has 81 keyword items, namely addition, adoption, advantage, AI technology, algorithm, analysis, application, area, aspect, bank, banking, benefit, blockchain, blockchain technology, business, company, compliance, concern, control, cost, cryptocurrency, digitalization, effect, efficiency, factor, finance, financial industry, financial institution, financial regulation, financial sector, financial service, financial system, financial technology, fintech, firm, framework, governance, government, growth, healthcare, impact, implementation, importance, industry, innovation, insight, investor, knowledge, lack, level, model, money laundering, new technology, opportunity, organization, overview, patient, performance, policy, policymaker, potential, practice, product, regtech, relationship, risk, risk management, robo advisor, rule, sector, security, service, solution, strategy, sustainability, system, term, time, transparency, trust, world.

A number of studies relevant to this research include research from Balakrishnan (2024) exploring the application of AI in monitoring, detecting, and preventing regulatory violations, with a focus on sanctions and Anti-Money Laundering (AML) efforts. Artificial Intelligence (AI) technology is revolutionizing the way financial institutions manage regulatory compliance, offering unprecedented opportunities for efficiency and accuracy. This research discusses how these technologies can process large amounts of data to identify patterns that indicate fraudulent activity, thereby improving the effectiveness of compliance programs. The paper also discusses the ethical and practical challenges of implementing AI solutions, such as data privacy concerns, the need for transparency in AI decision-making processes, and the requirement for human oversight. The research also underscores the potential of AI to transform regulatory compliance into a more proactive and predictive model, ultimately contributing to a safer and more trusted financial ecosystem. Thus, the research emphasizes the importance of fostering collaboration between regulatory authorities, financial institutions, and

technology developers to effectively navigate the complexities of integrating AI into compliance frameworks.

Truby et al (2020) examined AI regulation in the financial sector. The research explains that despite a growing international consensus on AI governance principles, lawmakers have so far failed to translate these principles into regulations in the financial sector. Artificial intelligence is rapidly impacting the financial sector with innumerable potential benefits, such as improving financial services and enhancing regulatory compliance. This research argues that the best way to foster a sustainable future for AI innovation in the financial sector is to support a proactive regulatory approach before financial losses occur. This proactive approach should implement rational regulations that embody jurisdiction-specific rules in accordance with carefully interpreted international principles.

Lee (2020) discussed the design of legal and regulatory frameworks for the use of artificial intelligence (AI) in the financial services market to improve access to finance (financial inclusion). The study states that AI development should continue to adhere to the regulatory objectives of market safety, consumer protection, and market integrity. However, to ensure equality and fairness, access to finance should be made a clear policy choice. The research also discusses how AI can lead to systemic risk and market manipulation on trading platforms. For example, by examining the use of algorithms for trading in capital markets, the authors understand the regulatory objectives and possible regulatory methods for peer-to-peer platforms. It also discusses how the use of AI to provide investment advice to consumers, such as financial advice provided by robo-advisors, could close the investment advice gap and provide consumers with access to finance. The current regime does not provide adequate protection to financial consumers in this regard. Further, the research also discusses how AI can be used as a form of RegTech to simplify the compliance process, thereby increasing competition in financial markets and providing benefits to consumers. However, this use may come into conflict with privacy, data protection and ethical concerns.

Other relevant research includes examining frameworks for understanding and addressing the increasing role of artificial intelligence ('AI') in finance, where it is concluded that the most effective regulatory approach to addressing the role of AI in finance involves humans through personal liability regimes, thus eliminating the black box argument as a defense to legal responsibility and liability for AI operations and decisions. Remolina (2022) analyzed the challenges posed by algorithmic credit scoring, including discrimination, limited consumer control, and financial exclusion. The research proposes regulatory solutions such as testing oversight processes, the establishment of a right to know algorithmic results, and data sharing initiatives to effectively protect consumers and promote fair lending practices.

Nimmagadda (2021) investigated the transformative potential of artificial intelligence (AI) in revolutionizing regulatory compliance and reporting within the banking sector. Hassan et al (2023) explored AI-based approaches for improved fraud prevention, risk management, and regulatory compliance in the banking sector. Raschner (2022) explored the legal and regulatory landscape regarding AI and ML disclosures by financial market participants in the EU, emphasizing the need for transparency to supervisory authorities as highlighted by IOSCO. Molton (2020) discusses AI regulation in the financial services sector. Noguer i Alonso & Samara Chatzianastasiou (2024) discuss the need for Artificial Intelligence (AI) regulation in the financial sector, emphasizing the balance between innovation and ethical responsibility and highlighting key regulatory foci such as transparency, fairness, and data privacy, while reviewing recent developments in AI regulation in the US, EU, and China, aiming to protect consumer interests and ensure the responsible use of AI in finance.

Cluster 2: The influence of AI on financial regulation

This cluster has 7 keyword items, namely child computer interaction, creation, declaration, financial interest, interest, personal relationship, work. Research that specifically discusses this topic is still quite small, and a number of studies related to this topic include Hidayat et al (2024) examining the impact of artificial intelligence (AI) on financial control, exploring the implementation of AI technology in financial decision-making strategies, predictive analysis, and risk manipulation. This research explains the use of AI in improving overall operational performance, providing deep insights for financial decision making, and improving customer experience in banking. It also highlights the ethical challenges, data security, adoption risks, and the need for policy and regulatory adjustments to the development of AI technologies in the context of financial management.

Qatawneh et al (2024) explained the mediating effect of financial technology (Fin-Tech) on the relationship between artificial intelligence (including natural language processing (NLP), machine learning algorithms, computer vision, predictive analytics, robotic process automation (RPA), blockchain technology and deep learning, and financial decision making from the perspective of financial managers in the commercial banking sector. The results explain that FinTech plays a significant mediating role between AI applications and financial decision-making. Machine learning was identified as the most impactful AI technique, facilitating more informed decisions through advanced data analysis and pattern recognition beyond the scope of traditional analysis methods.

Buchanan & Wright (2021) reviewed the significant influence of machine learning and artificial intelligence on the UK financial services industry, highlighting its impact on areas such as fraud detection, credit scoring, and algorithmic trading. This research also discusses the importance of regulation and governance in these applications and evaluates the performance of ML during the Covid-19 pandemic.

El Hajj & Hammoud (2023) analyzed the adoption and impact of artificial intelligence (AI) and machine learning (ML) in financial markets, revealing their growing use in areas such as algorithmic trading and risk management. The research highlights the need for financial professionals to adapt their skills and for organizations to address challenges, such as data privacy concerns, regulatory compliance, and ethical considerations.

Boffel (2023) examines the conflict between traditional insurance regulation and the innovation brought by artificial intelligence and new technologies, specifically in the context of California's rate-setting laws. The research highlights the need for regulatory reform to balance consumer protection with the benefits of financial innovation, suggesting a narrowed public inspection approach and the establishment of a regulatory sandbox to facilitate this transition. Additionally, the research emphasizes the importance of AI expertise among board members to navigate the challenges posed by these technologies.

Pan et al (2024) investigated the impact of government adoption of artificial intelligence (AI) on the intensity of financial regulation in China from 2012 to 2022, and found that AI significantly strengthened regulatory efforts. The study highlights the influence of institutional environment and government transparency, revealing a nonlinear relationship and larger effects in eastern regions with strong governance and digital infrastructure.

Cluster 3: Financial AI regulatory compliance and covid-19 pandemic

This cluster has 2 keyword items, namely covid, pandemic. Very little research on this topic has been found, among the relevant research is Piccialli et al (2021) discussing the role of artificial intelligence in fighting the COVID-19 pandemic. The Covid-19 pandemic has a significant impact on various aspects of life. Although the use of futuristic robotaxi and driverless commercial vehicles is not yet a reality, the COVID-19 pandemic has dramatically accelerated the adoption of Artificial Intelligence (AI) in various fields.

Guo & Polak (2021) discuss the development of Artificial Intelligence (AI) technology in finance, especially in the case of the COVID-19 pandemic in 2020. The regulatory framework for innovation at the regulatory level and mandatory restrictive guidelines and supervision for AI-based technologies to enable sustainable growth will drive the accelerated growth of AI in finance. AI in the financial industry itself focuses on the main characteristics of "digitalization", "onlineization", "remoteization", "visualization", and "intelligence", building an end-to-end system of all multifunctional processes based on data, enabling multi-user multi-terminal concurrent offices, intelligently assisting in handling problems and providing solutions. The rise of AI and its increasingly widespread effects on other industries demand an assessment of its influence in achieving sustainable development goals.

Priyadarshini et al (2022) discuss the transformative impact of Artificial Intelligence, Internet of Things, and cloud computing on the banking and financial services sector during the COVID-19 pandemic. It highlights how these technologies are helping to reshape the traditional banking system while addressing challenges related to privacy, security, and regulatory compliance. Artificial Intelligence, cloud computing, and the Internet of Things are here to solve the crisis. Artificial Intelligence and IoT are helping reshape the traditional banking system and financial institutions into technological advancements. Besides, cloud is important in today's economy because it has high security and confidentiality value. To benefit, the financial industry must incorporate cloud computing. Banks should be careful when entering the cloud computing sector because cloud computing will provide many advantages for banking companies.

Although the use of cloud computing by the financial industry seems to be beneficial to companies and markets, the financial sector must overcome difficulties such as maintaining privacy, security, regulatory compliance, standardized interoperability, and service quality.

CONCLUSION

This research aims to find out the extent of the development of research on the theme of "*AI and Financial Regulation*" in the world. The results of the study show that the number of research publications related to "*AI and Financial Regulation*" there are 432 journal articles indexed by Dimension. Furthermore, based on the results of the analysis on bibliometric author mapping shows that Khan S; Treleaven P.; Chaquet-Ulldemolins J.; Trakman L; Gupta A.; Arman A.A; Kathuria S.; Wang Y; Chitimira H.; Kumar A; Li L; Li X; Choi J; Truby J; Mizuta T; Guo H; Bonsón E.; O'halloran S.; Munir A.F; Wang S; Sadok H; Yang C.Y.; Frolova E.E.; Chen J; Giudici P.; and Lui A are the authors who published the most on the theme of "*AI and Financial Regulation*". Furthermore, in the development of research related to "*AI and Financial Regulation*" based on bibliometric keyword mapping, it is divided into 3 clusters with the most used words being system, model, fintech, application, innovation, analysis, industry, impact, risk, bank, and impact. Based on frequently used keywords, it can be grouped into 3 research map clusters with topics that discuss *The use of AI in financial regulatory oversight, The influence of AI on financial regulation,* and *Financial AI regulatory compliance and covid-19 pandemic*.

REFERENCES

Ahmed, S., Alshater, M. M., El Ammari, A., & Hammami, H. (2022). Artificial intelligence and machine learning in finance: A bibliometric review. Research in International Business and Finance, 61, 101646. https://doi.org/10.1016/j.ribaf.2022.101646

Arora, A., Gupta, S., Devi, C., & Walia, N. (2023). Customer experiences in the era of artificial intelligence (AI) in context to FinTech: a fuzzy AHP approach. Benchmarking: An International Journal, 30(10), 4342-4369. https://doi.org/10.1108/bij-10-2021-0621

Bahoo, S., Cucculelli, M., Goga, X., & Mondolo, J. (2024). Artificial intelligence in Finance: a comprehensive review through bibliometric and content analysis. SN Business & Economics, 4(2), 23. https://doi.org/10.1007/s43546-023-00618-x

Balakrishnan, A. (2024). Leveraging Artificial Intelligence for Enhancing Regulatory Compliance in the Financial Sector. International Journal of Computer Trends and Technology.

Boffel, L. (2023). The Influence of Artificial Intelligence and Emerging Technologies on the Regulation of Insurance Companies in the US: An Exemplary Analysis of California's Rate Making Law. Berkeley Bus. LJ, 20, 254. https://doi.org/10.2139/ssrn.4115070

Brousse, C., Fliche, O., Joyez, J., & Uri, J. (2024). Artificial intelligence: Challenges for the financial system. Banque de France. Retrieved October 22, 2024, from https://www.banque-france.fr/system/files/2024-10/Artificial_intelligence_challenges_for_the_financial_system.pdf

Buchanan, B. G., & Wright, D. (2021). The impact of machine learning on UK financial services. Oxford Review of Economic Policy, 37(3), 537-563. https://doi.org/10.1093/oxrep/grab016

Buckley, R. P., Zetzsche, D. A., Arner, D. W., & Tang, B. W. (2021). Regulating artificial intelligence in finance: Putting the human in the loop. Sydney Law Review, The, 43(1), 43-81.

El Hajj, M., & Hammoud, J. (2023). Unveiling the influence of artificial intelligence and machine learning on financial markets: A comprehensive analysis of AI applications in trading, risk management, and financial operations. Journal of Risk and Financial Management, 16(10), 434. https://doi.org/10.3390/jrfm16100434

Ellex. (n.d.). AI and challenges for financial companies. Ellex. Retrieved October 22, 2024, from https://ellex.legal/ai-and-challenges-for-financial-companies/

Elouidani, R., & Outouzzalt, A. (2022, May). Artificial Intelligence for a Sustainable Finance: A Bibliometric Analysis. In International Conference on Advanced Intelligent Systems for Sustainable Development (pp. 536-551). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-26384-2_46

Goodell, J. W., Kumar, S., Lim, W. M., & Pattnaik, D. (2021). Artificial intelligence and machine learning in finance: Identifying foundations, themes, and research clusters from bibliometric analysis. Journal of Behavioral and Experimental

Finance, 32, 100577. https://doi.org/10.1016/j.jbef.2021.100577

Grzybowski, A., Pawlikowska-Łagód, K., & Lambert, W. C. (2024). A history of artificial intelligence. Clinics in Dermatology, 42(3), 221-229. https://doi.org/10.1016/j.clindermatol.2023.12.016

Guo, H., & Polak, P. (2021). Artificial intelligence and financial technology FinTech: How AI is being used under the pandemic in 2020. The fourth industrial revolution: implementation of artificial intelligence for growing business success, 169-186. https://doi.org/10.1007/978-3-030-62796-6_9

Haenlein, M., & Kaplan, A. (2019). A brief history of artificial intelligence: On the past, present, and future of artificial intelligence. California management review, 61(4), 5-14. https://doi.org/10.1177/0008125619864925

Hassan, M., Aziz, L. A. R., & Andriansyah, Y. (2023). The role of artificial intelligence in modern banking: an exploration of AI-driven approaches for enhanced fraud prevention, risk management, and regulatory compliance. Reviews of Contemporary Business Analytics, 6(1), 110-132.

Hidayat, M., Defitri, S. Y., & Hilman, H. (2024). The Impact of Artificial Intelligence (AI) on Financial Management. Management Studies and Business Journal (PRODUCTIVITY), 1(1), 123-129. https://doi.org/10.62207/s298rx18

International Organization for Standardization. (n.d.). What is AI? ISO. Retrieved October 22, 2024, from https://www.iso.org/artificial-intelligence/what-is-ai

IOA Global. (n.d.). Role of AI in finance. IOA Global. Retrieved October 22, 2024, from https://ioaglobal.org/blog/role-of-aI-in-finance/

Jean, A. (2020). A brief history of artificial intelligence. Medecine Sciences: M/S, 36(11), 1059-1067. https://doi.org/10.1051/medsci/2020189

Kanaparthi, V. (2024). Transformational application of Artificial Intelligence and Machine learning in Financial Technologies and Financial services: A bibliometric review. arXiv preprint arXiv:2401.15710. https://doi.org/10.48550/arXiv.2401.15710

Khalifah, M. H., Kasri, R. A., & Aslan, H. (2024). Mapping the evolution of ZAKAH theme publications years 1964-2021: a bibliometric analysis. *Journal of Islamic Accounting and Business Research*, *15*(2), 265-290.

Lee, J. (2020). Access to finance for artificial intelligence regulation in the financial services industry. European Business Organization Law Review, 21(4), 731-757. https://doi.org/10.1007/s40804-020-00200-0

London School of Economics. (2024, August 5). How AI challenges prudential regulation. LSE Philosophy Blog. Retrieved October 22, 2024, from https://www.lse.ac.uk/philosophy/blog/2024/08/05/how-ai-challenges-prudential-regulation/

Mi'raj, D. A., & Ulev, S. (2024). A bibliometric review of Islamic economics and finance bibliometric papers: an overview of the future of Islamic economics and finance. *Qualitative Research in Financial Markets*, 16(5), 993-1035.

Molton, T. (2020). Regulation of AI within the Financial Services Sector. The AI Book: The Artificial Intelligence Handbook for Investors, Entrepreneurs and FinTech Visionaries, 217-219. https://doi.org/10.1002/9781119551966.ch58

Nahar, J., Jahan, N., Shorna, S. A., & Joy, Z. H. (2024). Foundations, Themes, And Research Clusters In Artificial Intelligence And Machine Learning In Finance: A Bibliometric Analysis. Academic Journal on Science, Technology, Engineering & Mathematics Education, 4(03), 63-74. https://doi.org/10.69593/ajsteme.v4i03.89

Napitupulu, R. M., Sukmana, R., & Rusydiana, A. S. (2024). Governance of Islamic social finance: learnings from existing literature. *International Journal of Islamic and Middle Eastern Finance and Management*, *17*(3), 552-571.

Nimmagadda, V. S. P. (2021). Artificial Intelligence for Compliance and Regulatory Reporting in Banking: Advanced Techniques, Models, and Real-World Applications. Journal of Bioinformatics and Artificial Intelligence, 1(1), 151-189.

Noguer i Alonso, M., & Samara Chatzianastasiou, F. (2024). The Case for Artificial Intelligence Regulation in the Financial Industry. Foteini, The Case for Artificial Intelligence Regulation in the Financial Industry (May 16, 2024). https://doi.org/10.2139/ssrn.4831147

Olan, F., Arakpogun, E. O., Jayawickrama, U., Suklan, J., & Liu, S. (2022). Sustainable supply chain finance and supply networks: The role of

artificial intelligence. IEEE Transactions on Engineering Management. https://doi.org/10.1109/TEM.2021.3133104

Özdemir, M., & Selçuk, M. (2021). A bibliometric analysis of the International Journal of Islamic and Middle Eastern Finance and Management. *International Journal of Islamic and Middle Eastern Finance and Management*, *14*(4), 767-791.

Pan, M., Li, D., Wu, H., & Lei, P. (2024). Technological revolution and regulatory innovation: How governmental artificial intelligence adoption matters for financial regulation intensity. International Review of Financial Analysis, 96, 103535. https://doi.org/10.1016/j.irfa.2024.103535

Pattnaik, D., Ray, S., & Raman, R. (2024). Applications of artificial intelligence and machine learning in the financial services industry: A bibliometric review. Heliyon.

Piccialli, F., Di Cola, V. S., Giampaolo, F., & Cuomo, S. (2021). The role of artificial intelligence in fighting the COVID-19 pandemic. Information Systems Frontiers, 23(6), 1467-1497. https://doi.org/10.1007/s10796-021-10131-x

Priyadarshini, K. V. L., Nath, A., Saha, U., Saha, S., Chakravarty, G., & Mukherjee, D. (2022). Pre and post changes of AI, IOT & cloud computing in financial services and banking sector during COVID-19 pandemic. International Journal of Health Sciences, (I), 11559-11574. https://doi.org/10.53730/ijhs.v6ns1.7859

Qatawneh, A. M., Lutfi, A., & Al Barrak, T. (2024). Effect of Artificial Intelligence (AI) on Financial Decision-Making: Mediating Role of Financial Technologies (Fin-Tech). HighTech and Innovation Journal, 5(3), 759-773. https://doi.org/10.28991/HIJ-2024-05-03-015

Raschner, P. (2022). Supervisory Oversight of the Use of AI and ML by Financial Market Participants. In Digitalization, Sustainability, and the Banking and Capital Markets Union: Thoughts on Current Issues of EU Financial Regulation (pp. 99-123). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-17077-5_3

Remolina, N. (2022). The role of financial regulators in the governance of algorithmic credit scoring. SMU Center for AI & Data Governance Research Paper, (2). https://doi.org/10.2139/ssrn.4057986

Rusydiana, A. S., Irfany, M. I., As-Salafiyah, A., & Tieman, M. (2023). Halal supply chain: A bibliometric analysis. *Journal of Islamic Marketing*, *14*(12), 3009-3032.

Rusydiana, A. S. (2021). Bibliometric analysis of journals, authors, and topics related to COVID-19 and Islamic finance listed in the Dimensions database by Biblioshiny. *Science Editing*, *8*(1), 72-78.

Rybakovas, E., & Žigienė, G. (2021, August). Is Artificial Intelligence a Magic Pill Enhancing SMEs Access to Finance? In 2021 IEEE International Conference on Technology and Entrepreneurship (ICTE) (pp. 1-6). IEEE. https://doi.org/10.1109/ICTE51655.2021.9584833

Shao, J., Lou, Z., Wang, C., Mao, J., & Ye, A. (2022). The impact of artificial intelligence (AI) finance on financing constraints of non-SOE firms in emerging markets. International Journal of Emerging Markets, 17(4), 930-944. https://doi.org/10.1108/ijoem-02-2021-0299

Truby, J., Brown, R., & Dahdal, A. (2020). Banking on AI: mandating a proactive approach to AI regulation in the financial sector. Law and Financial Markets Review, 14(2), 110-120. https://doi.org/10.1080/17521440.2020.1760454.