

The role of artificial intelligence in financial inclusion in emerging markets: A conceptual review

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Abstract: Technological advancements have significantly transformed the financial services industry with the increasing implementation of artificial intelligence (AI). Therefore, the rapid growth of AI and its potential to drive financial inclusion, particularly in emerging markets, has highlighted a critical research gap in the conceptual and theoretical frameworks. This gap continues to stifle the effective application of AI in the financial domain. This study is unique because it merges social influence and ethical considerations into the TOE framework and DOI theory to enhance the existing body of knowledge. We propose that technological and organizational readiness, social influence, and ethical considerations are key drivers of AI adoption and promoters of financial inclusion. An integrative review covering the period from 2018 to 2023 and based on the Scopus database, combined with a bibliometric approach, was employed to analyze the growth of the literature, identify leading countries in AI research, and establish key themes and keywords. This study provides a holistic perspective on existing academic studies using the proposed model based on a comprehensive review of the AI and financial inclusion literature. It also identifies key propositions for future research and emphasizes the role of managers and decision-makers in driving AI adoption and supporting societal development.

Keywords: Artificial intelligence (AI), Emerging market, Ethical considerations, Financial inclusion, Industrial growth, Organizational readiness, Social influence, Technological readiness.

1. Introduction

The financial industry has offered financial services since 2000 BC. Owing to supply and demand, businesses and economic systems have grown to provide a wider range of goods and services as the world's population has increased [1]. The rise of information and communication technology (ICT) has brought about significant and transformative changes in the business and financial sectors by integrating technology into financial services [2]. Consequently, business models have evolved to continuously adapt to technological advancements driven by human creativity.

Technology integration into business operations can be traced back to the period between 1866 and 1987, marked by using transatlantic cables and trading telegraphs [3]. Historically, Fintech 2.0 started in the financial industry, which shifted toward digitization between 1967 and 1987, when the first Automated Teller Machines (ATMs) were installed in London in 1967. As a result, the banking sector has been revolutionized by offering clients unprecedented convenience. This era saw significant advancements in information technology, increased knowledge sharing, and improved collaboration through integrating Internet services and automated clearing services in U.S. bank [3]. By combining Internet services and automated clearing services in U.S. banks, this era witnessed tremendous advancements in information technology, a rise in knowledge sharing, and enhanced collaboration.

The second FinTech era was from 1987 to the early 2000s, marked by a period of rapid digital transformation and infrastructure development [4]. The main innovations that appeared during this period were Internet banking, SWIFT, ATMs, and online payments [3, 4]. During this period, regulatory frameworks were developed to align with digital transformation, as regulations have played

an important role in supporting emerging financial technologies and mitigating associated risks, with initiatives such as the Basel Commitment and FinTech regulations in the United States and the United Kingdom driving these developments [5]. Advanced technology and regulations originating in developed countries, such as the United States and the United Kingdom, influence consumer expectations and business practices globally [3].

The technological revolution reshaped the financial sector by introducing new competitive pressure and giving rise to business models that integrated technology into financial services. This has resulted in the emergence of fintech startups in both developed and developing countries [3]. Fintech startups aim to deliver financial services traditionally offered by banks through digital channels that improve access to financial services for individuals and organizations facing solvency limitations [6]. Emerging markets present an opportunity for innovative financial models to enhance accessibility [7]. Consequently, technological advancements, such as artificial intelligence (AI) and big data, have further supported this business model, driving market expansion, reducing operational costs, and encouraging new market entrants. Emerging as a major technical innovation in the twenty-first century, Industry 4.0 has propelled financial inclusion, sustainability, and economic development [8]. AI is one of the key developments in Industry 4.0, has significantly impacted the financial sector, particularly in developing countries [9]. AI enhances financial services by improving products, increasing business performance, and generating societal benefits [9, 10]. AI-driven products, including chatbots and machine learning (ML), leverage large datasets to deliver high-precision insights into customer behaviour and preferences, thereby improving service quality and customer satisfaction [11]. Digital transformation provides new financial products in emerging markets, such as digital payments, mobile banking, cryptocurrencies, peer-to-peer (P2P) lending, crowdfunding platforms, robo-advisors, shadow banking, digital banking, and regulatory technology (RegTech). These innovations have played a transformative role in enhancing financial inclusion [12].

In the financial industry, contemporary AI systems automate several procedures, including financial transactions and customer support [13]. For example, data entry and validation can now be handled by AI-powered chatbots, resulting in faster service delivery, increased productivity, higher customer satisfaction, and improved accuracy at a reduced cost [13]. AI combines advances from Industry 4.0 to provide data-driven insights that enhance decision-making and extend financial services to underserved populations [14]. AI-driven applications extend beyond the financial sector, supporting functions such as sales, customer service, investment analysis, and education, thereby creating new opportunities to improve the quality of life [13, 14].

AI-driven financial services operate at 24 hours, which leads to increasing efficiency and reducing operational costs. Furthermore, it is estimated that AI could save banks approximately \$8 billion annually by 2022, while the global banking sector could save \$7.3 billion by the end of 2023 through AI integration [15]. By 2025, the global AI market is projected to reach \$190 billion, with significant investment growth expected by the end of 2024, resulting in substantial revenue increases [16]. AI is expected to enhance financial inclusion by providing financial solutions that address individuals' needs across all income levels without requiring new financial instruments, thereby promoting sustainability in the banking sector [15].

Studies highlight the need for increased investment in AI to improve financial services and customer interaction [17]. The Financial products have been driven by AI to offer new models that address financial challenges. For example, blockchain drives decentralized finance (DeFi) to improve financial insights and increase inclusivity, sustainability, and efficiency [18]. AI improves financial literacy, facilitates well-informed investment decisions, and opens up new avenues for financial inclusion [19-21].

The banking sector has progressively embraced AI to improve its products and meet the financial needs of middle- and lower-income consumers [22]. Competitiveness is increased and the successful adoption of AI is facilitated by organisational preparedness, economic conditions, and technical and human capabilities [23]. Furthermore, AI and big data improve decision making regarding customer

creditworthiness and financial risk, driving financial organizations to adapt their business models and enhance their public image [24].

Regardless of technological advances in ICT, financial institutions struggle to adopt AI due to technological, organizational, and environmental intricacies. The DOI theory along with the TOE framework analyses the technology, organization, and environment with regard to readiness and organizational maturity, outlining the support structure available for implementing AI adoption [5]. The Diffusion of Innovation (DOI) theory and the Technology-Organization-Environment (TOE) framework provide valuable insights into the factors that drive AI adoption, and the challenges involved, including technology readiness, organizational maturity, and environmental support. Overcoming these challenges need aligning business environments with technological improvements and building organizational capabilities. Prior research indicates that organizational readiness and technological capacity are critical for successfully adopting AI [25]. The financial sector needs to enhance its technical and human competencies to integrate AI and improve profitability and service quality. Tech evolution, such as digital banking, offers cost-effective solutions to the challenges of expanding physical banking infrastructure, particularly in low-income markets [12].

Existing research on AI adoption in the financial sector, particularly in emerging markets, is limited. This study addresses this gap by developing theoretical propositions that identify the key drivers of AI adoption and its impact on financial inclusion using DOI theory and the TOE framework. By expanding the body of AI literature, this study clarifies the complex process of AI adoption and its implications for financial inclusion and sustainability in emerging economies.

2. Research Design

The purpose of this study is to determine the main forces behind the financial industry's adoption of AI and how they affect financial inclusion. The literature has various methods, including systematic reviews, narrative reviews, integrative reviews, systematic reviews with meta-analyses, semi-systematic reviews, and review papers [26]. This study used an integrative review and bibliometric approach utilizing keyword-based filtering to focus on AI and financial inclusion. This method is particularly suitable for identifying quantitative and qualitative studies that support the research framework and propositions [26]. Additionally, a bibliometric analysis was applied to examine trends in the volume of scientific research on AI and financial inclusion, identify leading countries in scientific publications, and establish keyword-based thematic classifications. A bibliometric approach was chosen to uncover gaps in the literature and highlight the need for further research, particularly in emerging economies, to advance knowledge in this field.

According to Öztürk, et al. [27] Web of Science and Scopus are the two largest academic databases, with a significant overlap in the fields of business and management. Based on a comparative analysis of these databases confirmed that Scopus contains the majority of relevant publications, with substantial duplication between the two [27]. To avoid redundancy, this study exclusively utilized Scopus owing to its broad interdisciplinary coverage, user-friendly interface, extensive collection of high-quality journals, and strong reputation in economics and social sciences. This approach is consistent with prior studies, such as Pandey, et al. [28]; Raman, et al. [29] and Younis, et al. [30] and aims to minimize bias while ensuring comprehensive literature coverage of AI and financial inclusion. The selected articles were published within the last five years, with data ranging from 2018 to 2023, as illustrated in Figure 1. Keywords were refined to enhance accuracy and specificity, ensuring the inclusion of relevant scientific publications that comprehensively explored AI's role of AI in the financial sector. Expanding these keywords enabled the collection of a broad range of articles, enriching the existing literature and identifying trends in AI and financial inclusion research. Keywords were selected based on their relevance to the research topic, frequency in the literature, alignment with key AI, and financial inclusion concepts. The inclusion criteria were restricted to peer-reviewed journal articles published within the last five years, specifically in the fields of business, management, accounting, economics, econometrics, and finance. Studies that did not directly address AI adoption or financial considerations

were also excluded. The analytical process involved a systematic review of the studies retrieved from Scopus with a focus on extracting relevant data to develop the propositions of the research framework. A cross-check with Web of Science revealed that most articles appeared in both databases. Therefore, Scopus was selected to minimize duplication and ensure the reliability of the dataset. The flow diagram below shows the processing of the existing AI and financial inclusion literature.

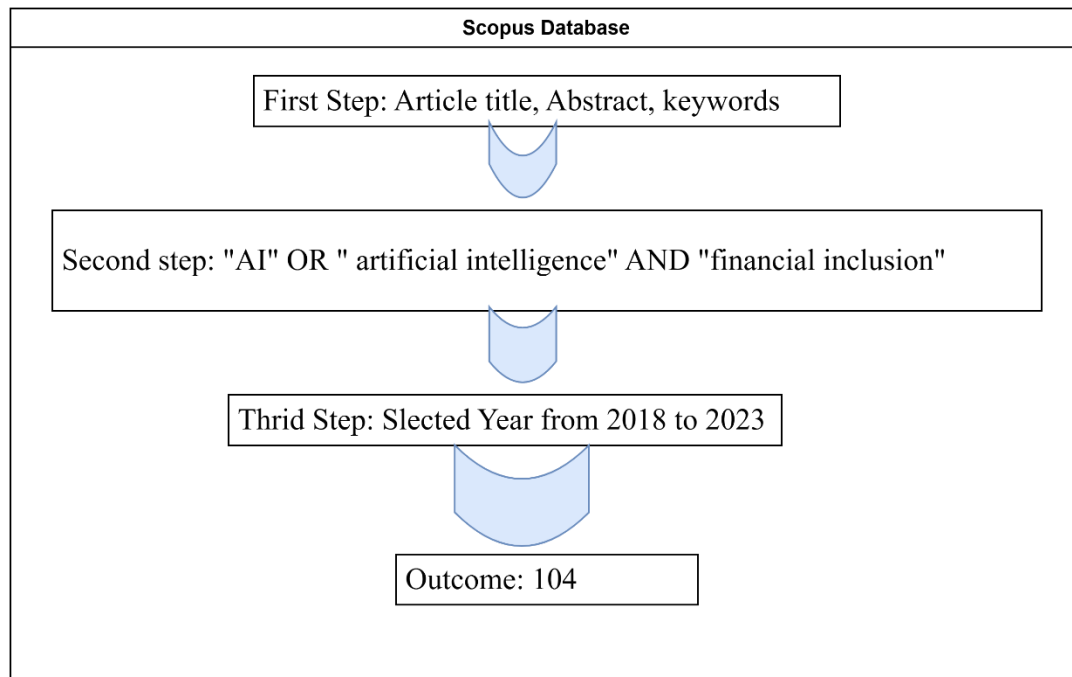


Figure 1.
Literature processing approach.

3. Descriptive Analysis

This section analyses the annual number of publications, countries active in publications, and keywords to understand the conceptual development of the AI literature on financial inclusion.

3.1. Number of Publications

Figure 2 illustrates the annual number of publications investigating AI in the Scopus database. The data reveal that AI had garnered significant scholarly interest since 2017, when it emerged as a key phenomenon in a financial research study focused on enhancing payment security within financial inclusion projects. No articles on this topic were published in 2018. However, by 2019, the number of publications had increased to eight. The early research examined the role of financial and technological advancement in transforming the financial sector, explored how financial technology contributes to enhancing financial inclusion, and proposed theoretical frameworks for implementing Tech evolution in financial institutions [31]. This study's overarching objective was to highlight the role of Fintech in promoting digital financial inclusion, addressing challenges such as regulatory impacts on the financial sector, the integration of intelligent systems such as robot advisors and social banking frameworks, and the disruption caused by new market entrants. These studies emphasize the potential of Fintech to bridge financial gaps and drive innovation across the financial sector.

By 2020, the number of publications investigating AI had increased to 13, and these researchers increasingly focused on digital finance, credit risk, and the role of fintech in enhancing financial

inclusion. Many studies have examined the impact of AI and ML on credit risk analysis and their contribution to poverty alleviation, thereby fostering sustainability. In 2021, the number of publications rose to 17, reflecting a significant trend towards research on the impact of AI and ML in promoting sustainability. These studies underscore applications such as poverty reduction, the improvement of education in agriculture, and the advancement of financial inclusion. Additionally, researchers have investigated the use of AI and ML to effectively evaluate credit risk in the banking sector, which enhances financial inclusion.

In 2022, the number of publications reached 22 articles, illustrating a remarkable interest in studying the impact of big data and AI on financial inclusion. The primary areas of interest encompass increasing access to financial services, driving growth, improving efficiency, and understanding how robot advisors aid and interact with consumers. Finally, by 2023, the number of publications doubled compared to the previous year, as AI solidified its position as a trending research topic in the financial sector. Most of these studies concentrated on developing conceptual frameworks for integrating AI into financial systems to enhance financial inclusion. They also addressed the creation of innovative financial instruments and the provision of solutions to support sustainability goals. AI has become a desirable technology for implementation in the financial sector because it offers significant advantages in advancing technological innovation and achieving sustainability objectives.

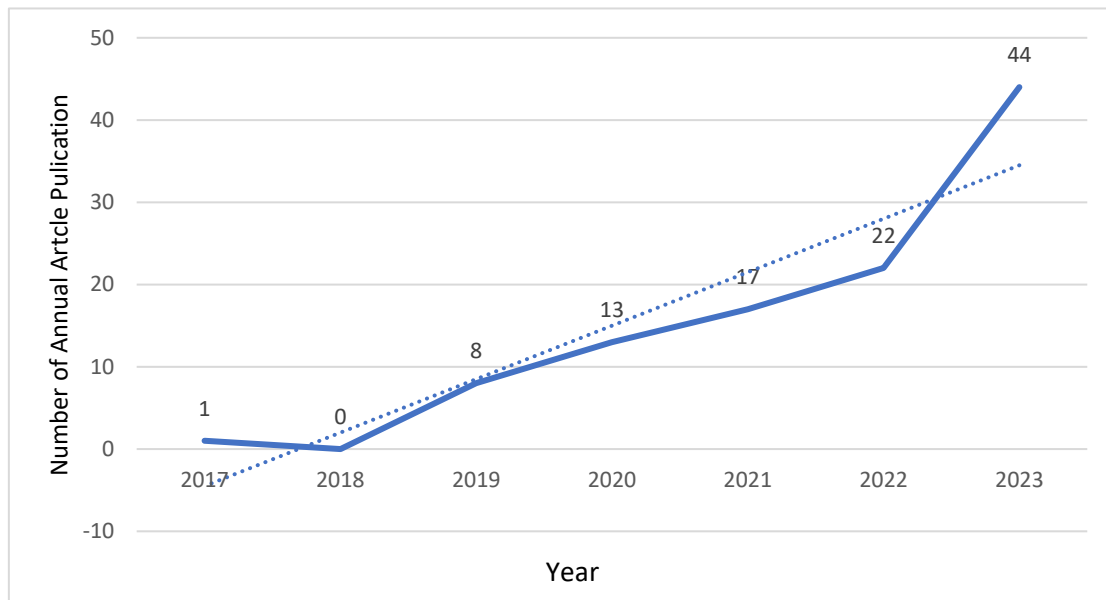


Figure 2.
Number of annual article publications.

3.2. Countries Active in Publications

Figure (3) shows the top ten countries producing academic scientific publications from 2017 to 2023, as recorded in the Scopus database. The findings indicate that the leading countries in publication output are among the top global economies: India, China, and the United States, with 30, 16, and 12 publications, respectively. It is clear that the dominance in publication output is primarily attributed to countries with advanced economies and high population densities, as illustrated in Figure 3. These countries need to integrate AI into their financial sectors to enhance their financial inclusion. By doing so, they aim to reduce costs, simplify the entry of new financial organizations into the market, and serve segments of the population that currently lack access to banking services. The runners in publication output were emerging economies: the United Arab Emirates, Malaysia, Bahrain, and South Africa, with

10, 7, 6, and 6 publications, respectively. It is evident that researchers in emerging economies often focus on the growth of Fintech in the financial industry and its role in guiding financial service providers toward achieving sustainability goals. Additionally, many scholars have explored the role of AI and big data in evaluating borrowers' risk history to increase transparency and provide insights into customer conditions when seeking financing [32, 33].

Findings from both emerging and developed economies suggest that AI and ML play significant roles in the financial sector. These innovations enhance decision-making, simplify the entry of new service providers into the industry, improve quality of life, boost customer satisfaction, and support the sustainable development of financial services to benefit all segments of society. However, empirical studies have not explored the factors driving AI adoption in the financial sector, particularly their direct role in enhancing financial inclusion. This study addresses this gap by proposing a framework to clarify the processes involved in AI adoption and the key factors influencing it.

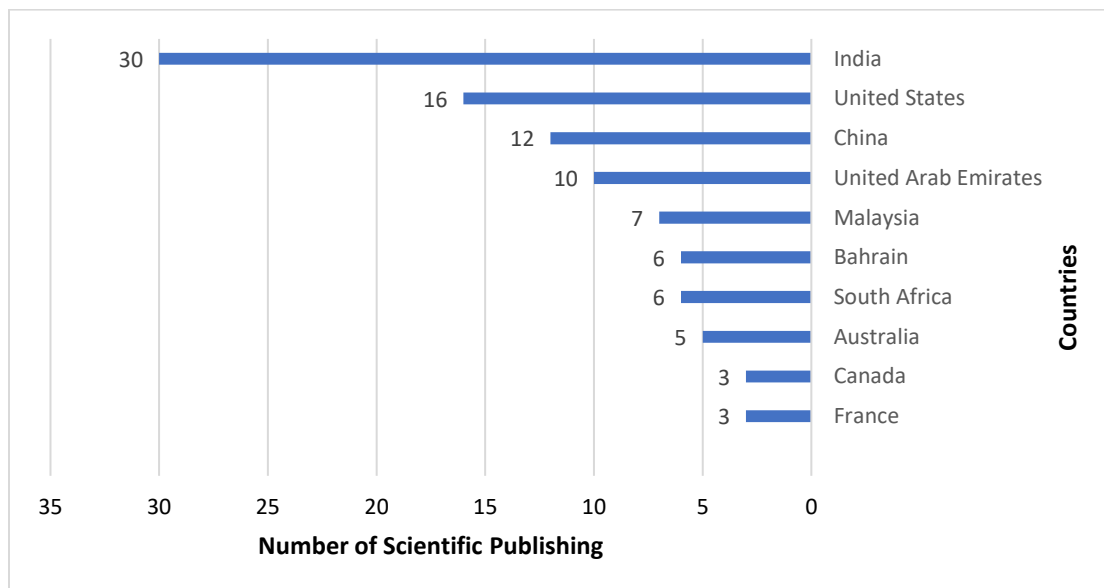


Figure 3.

Top ten countries actively contributing to scientific publications on AI and financial inclusion.

3.3. Keywords Analysis

The VOSviewer tool was used to analyse the overlay visualization network of keyword frequencies by setting the minimum frequency occurrence criterion to three. This approach aimed to understand the conceptual development of literature through keywords, as shown in Figure 4. This Figure highlights the evolution of the frequency of keywords, reflecting the progression of the topics investigated in the literature each year. For example, the frequency of keywords in 2021 indicates that research trends focus on issues such as AI, Fintech, data mining, electronic money, population statistics, and credit scoring. By 2022, the thematic focus had shifted, with topics such as blockchain, ML, decision-making, investment, financial inclusion, and economic and social impacts. By 2023, the frequency of keywords highlighted themes related to financial innovation, ML, blockchain technology, and commerce. These evolving keyword frequencies reflect the changing priorities and focal points in the AI and financial sector literature.

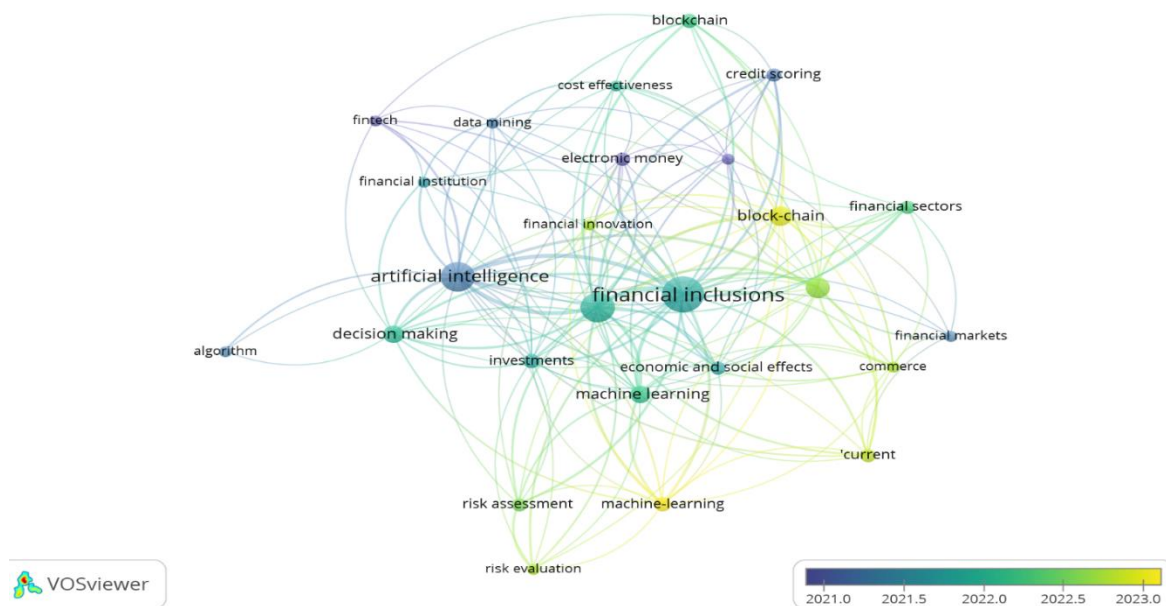


Figure 4.
Keyword frequency.

4. Literature Review

4.1. Artificial Intelligence

AI has multiple definitions, and specific issues and fields often shape its interpretation and application. The main aim of AI is to address and provide solutions to relevant challenges by implementing technology that performs mind-like computations [8, 22]. The general concept of AI revolves around the ability to understand issues and provide solutions through reasoning; therefore, it enables technology to offer solutions in business by learning and analysing to make ideal decisions [8]. AI is one of the pivotal components of Industry 4.0, spearheading the development of algorithms that enable computers to interact directly with customers through AI applications such as chatbots [11, 13]. Furthermore, the prospect of leveraging Industry 4.0, by adopting AI, is increasingly attractive to business owners and managers across both the public and private sectors to enhance services, reduce costs, seek new opportunities, and create value [5, 34].

Existing studies indicate that AI enhances banking value by adding \$1 billion annually to the global banking sector [22]. Likewise, Eren [13] pointed out that AI products such as chatbots enable solutions and assist clients in accessing financial services, leading to an increase in the administration of financial services by fulfilling and satisfying customer needs at any time [13]. Furthermore, AI reduces the risks associated with finance by increasing efficiency and opening avenues for opportunities [35]. Additionally, AI assists decision-makers in making the best choices to maximize profits by analysing risk management and making recommendations based on investment prospects [9]. In addition, AI enhances fraud detection and sustainability and addresses information asymmetry [8]. Thus, technological innovation is critical for reducing expenses and minimizing human error. The financial sector has also utilized AI to depict financial services, increase service options, and drive DeFi in the financial industry [18]. However, it is vital to consider the potential downsides of AI, particularly its disruptive impact on socioeconomic systems, when ethical considerations are lacking. This can result in adverse effects, such as job displacement and algorithmic bias. However, AI can positively impact when moral standards are implemented to promote financial inclusion and ensure algorithmic fairness, transparency, and autonomy.

Digital banking and business services that are currently emerging have led to a reduction in the cost of financial services and an increase in the provision of financial solutions tailored to customer demand, covering all consumer needs at all income levels [22]. Consequently, these emerging digital services will increase consumption and contribute to GDP growth [36]. Furthermore, AI is critical in driving DeFi by presenting new opportunities for service providers to broaden access, reduce monopolies, and foster new financial provision systems that connect lenders and borrowers [18]. Additionally, AI helps banks bolster their operational efficiency by reducing instances of fraud [37].

Based on the study by Zhou and Zheng [38] AI significantly improves the customer experience by providing adequate and adaptable financial services. This entails using AI to represent services and support clients whenever they require assistance. This boosts client loyalty to competitive banking. Furthermore, the development of AI has led to it becoming a significant resource for improving human life through its application in areas such as education, investment, advice, and other human needs [34]. AI applications can diversify services to impact human income by reducing costs and enabling access to all financial services, thereby providing financial resources to enhance livelihoods and improve the environment [34]. By transitioning from a conventional paradigm to a contemporary corporate paradigm, which has a lower environmental impact and raises social income, AI provides solutions for enhancing lives, overcoming challenges, and improving sustainability [9]. This is accomplished by reshaping financial resources and human demand through technological innovation. AI also assists society by raising awareness and knowledge and enhancing financial literacy [39]. Many studies have shown that AI is a significant solution for enhancing financial inclusion by providing various models and opportunities to improve community and societal outcomes, enhance economic growth and sustainability, and reduce negative environmental impacts [1, 39, 40].

4.2. Technological Readiness

In AI adoption, digital readiness refers to an organisation's willingness and capability to adopt AI based on its relative advantages, culture, resources, data, vision, and knowledge [21]. Furthermore, an organization's capacity to implement new technology is determined by its level of technological readiness to align with the characteristics of AI Abed [41] and Lai, et al. [42]. Sahin [43] discusses that knowledge of whether social, economic, personal, or related to communication behaviour is the first step towards accepting new technology and a factor that will expedite the adoption process, reduce uncertainty, and improve societal outcomes [43]. Based on previous studies by Horani, et al. [44] and Hmoud, et al. [45] the technical perspective depicts how a company adopts new technological advances based on the added value and preparedness of its technological infrastructure.

Uren and Edwards [23] pointed out that successful AI implementation requires data availability for processing interactions. High technological maturity allows organizations to implement new technologies at a reasonable cost [23]. Organizations' evaluation of the relative advantages of AI to enhance their value and exceed the existing benefits of traditional models will lead to the effective integration of the new system with existing ones [5]. Value includes a financial firm's ability to enhance its services and access all community income levels to improve finance inclusion. However, organisations' lack of technological infrastructure readiness increases the pressure and challenges they face when adopting AI Kumar, et al. [46]. Kumar, et al. [47] argued that Insufficient resources and outdated systems that do not correspond to contemporary advancements lead to increased expenses and a lack of flexibility within the company [46]. As a result, the company loses its ability to implement strategies that boost business performance and streamline operations while providing services that appeal to customers' current needs. Technological readiness refers to the capability of existing systems to adapt to the AI system requirements.

In contrast, compatibility indicates high integration and simplification in adopting AI within organizations, as observed from the organizational perspective of DOI theory Yu, et al. [5]; Abed [41] and Lai, et al. [42]. Moreover, AI provides features that optimize the advantages gained by its adoption compared with conventional models [5]. For example, AI shifts the financial sector's system towards

digitalization and lowers operating costs by having chatbots perform certain tasks and provide services to all communities without temporal or spatial restrictions that support sustainability. Businesses are encouraged to understand the positive aspects of improving operations, optimizing profitability, and positive impact on society through the continuous advancement of technology [39]. The lack of technological readiness has hindered the adoption process, resulting in higher implementation costs and lower efficiency in utilizing AI across services and operations. This challenge stems from insufficient experience and inadequate preparation, further complicating the adoption process.

Since 1987, technological progress has led to changes in regulations and safety standards to reduce potential dangers and obstacles to the effective use of new technologies [3]. For example, cybersecurity measures have been enhanced to protect privacy and ensure digital transformation's safety, thereby improving technological innovations' success rate [48]. Therefore, increasing safety enhances the adoption of AI within business sectors, leading to improved business practices, financial resources, and sustainability [18]. Technological readiness refers to people accepting innovative technological services [49]. It has been argued that technological readiness is not limited solely to physical technology elements, knowledge, and skills; it also encompasses customer acceptance of technology-driven innovation. According to the literature, AI implementation enhances the sustainability of goals by directing financial organizations to reform all available resources to address innovation challenges and sustainability [21, 49, 50].

4.3. Organizational Readiness

Organizational readiness refers to an organization's ability to employ resources to integrate new AI technologies into its operations. Organizational components, such as size, financial allocation, employee experience, leadership, and strategy, play crucial roles in the AI adoption process [5, 44, 50]. Leaders are responsible for modifying procedures, allocating funds to integrate new technology into an organization's operations, and instructing staff members on how to use the technology and help improve it [51]. An organization's willingness to utilize its tangible and intangible assets is critical for successfully implementing AI to find competitive advantages that enhance business. [40], referred to how AI impacted society; thus, AI is enhancing new financial channels to deliver services to the community. Providing new financial instruments at low cost is essential to support society.

The successful implementation of AI is driven by a firm's internal or external resources [52]. When these resources are prepared to accept a new system, the implementation of innovation in an organization is successful [5]. However, when an organization is unprepared, this lack of preparation is a barrier to adopting technological innovation. Furthermore, organizations have not been successful in addressing environmental challenges.

One factor that poses a challenge for organizations when adopting AI in emerging economies is organizational infrastructure, as there is often a lack of available data, system techniques, and resources [5, 51]. This increases challenges, including the need for extensive staff training to understand the complete tasks associated with AI adoption [53]. Hence, organizational readiness enables organizations to offer solutions and obtain competitive advantages to enhance profitability and readiness to succeed in the future challenges that threaten existing products and services [21]. Therefore, digital transformation significantly affects financial inclusion.

Despite the escalating challenges of AI adoption today, businesses face fierce competition and ongoing development owing to technological innovations and growing leadership awareness regarding the importance of utilizing these advancements in operations and functions to improve quality, efficiency, and sustainability [5, 51]. Hence, organizations continuously enhance their readiness to prepare for environmental changes threatening their profits and social impact. Furthermore, organizations need to improve their reputation by supporting lower-income levels based on capability and creating new avenues.

Given the radical changes in the financial landscape, organizational readiness has become an important strategy [54]. By improving business operations and preparedness, organizations seek to

lower operating expenses while empowering themselves to use their resources better to explore more varied revenue streams and avenues for resource distribution to all community groups [21, 55]. The usefulness of AI in enhancing an organization's strategy to help it recover its resources and implement the strategy is evident [20]. Additionally, needs and values increase organizations' willingness to use AI to enhance financial inclusion. Therefore, based on leaders' knowledge and experience of market needs and the changing business landscape, leadership is a significant factor in organizational readiness to implement advancement of Tech aimed at achieving sustainable competitive advantages [5]. Organizations enhance their infrastructure by adopting AI to improve decision-making and utilizing their resources to enhance their capabilities, thereby gaining a competitive advantage by improving their image to serve society [51, 54]. Overall, organizational readiness enhances financial inclusion by enabling organizations to implement AI to support all segments of society.

4.4. Social Influence

The term 'social influence' describes how a person's social surroundings, such as friends, family, and coworkers, affect their behaviour, which is affected by trust and knowledge [7, 56, 57]. The fundamental tenet of social influence is that individuals may be persuaded to use digitalization services through their social networks to support or endorse cutting-edge technology services in society [6]. Additionally, it relates to how consumers behave individually towards financial Tech advancement and how satisfied they are with the adoption of AI, which significantly impacts an organization's decision to implement new technology [58].

Society is one of the most important aspects that organizations should consider when meeting their customers' basic needs and desires because they can be barriers to adoption Cubric [56]. Gursay, et al. [57] highlighted that an organization's capacity to address the basic needs of society through integrating technology into its services and goods is a key component in its success in satisfying consumers.

Social influence refers to the advantages people expect from adopting new Fintech, which creates value for consumption [6]. Moreover, customers trust technology that enhances their expectations and simplifies the use of services or products in their final consumption [56]. Therefore, AI enhances services to increase customer satisfaction and improve customer experience [13, 14]. Disruptive AI innovation offers new technology and digital solutions that will enhance financial inclusion by providing low-cost services and new economic models, such as Fintech startups that support individuals unable to access bank financial services [16, 59]. Thus, AI enhances personalized services, provides easy access to economic goods, and facilitates smooth interaction via online and mobile platforms. Consequently, client loyalty increases when banks offer their clients more access to digital services that serve all segments of society. Additionally, the process automation brought forth by AI innovation increases the effectiveness of banking operations and produces reliable data analysis [14, 20].

Some studies indicate that social influence is an important aspect that organizations consider when adopting AI because it provides an index of the importance of customer demand for technology [6, 7, 14]. Integrating AI in banking adds value by augmenting client experience, increasing operational effectiveness through automation and data analysis, and cultivating a Fintech environment [20]. Additionally, it offers intangible financial gains by improving the client base and the organization's reputation, making social influence one of the main forces driving technological advancement. Social aspects influence businesses to adapt to emerging needs; otherwise, market gaps and opportunities may arise [60]. Consequently, organizations adopt AI innovations to update their service channels and develop sophisticated technological solutions to implement their services to break the barrier of geographical boundaries [59]. Further, Social acceptance of technological innovation occurs when trust is established, motivating financial organisations to use AI products and services to leverage AI innovations to enhance financial inclusion [56].

4.5. Ethical Considerations

Ethical standards translate foundational ethical principles into actionable guidelines tailored to AI systems [61]. These standards align AI implementation with governance frameworks and regulatory roles, thereby enhancing the financial sector and promoting financial inclusion to improve societal well-being. The majority of studies emphasize the significance of AI ethics standards, highlighting their benefits in fostering environmental sustainability, respecting human dignity, and protecting community rights, including privacy and security [35, 62]. These standards also address critical aspects of AI integrity, such as autonomy, fairness, explicability, transparency, and accountability [35]. Within the framework of the TOE model, AI ethics reveal how regulatory support drives AI adoption, promoting financial inclusion and enhancing societal well-being [17]. Ethical AI including a set of principles and standards aimed at safeguarding the rights of stakeholders, including investors, business owners, financial systems, economies, and society [35]. However, the concept and application of ethical AI vary significantly across different cultures, regions, and industries [35]. According to the change landscape of the business that the AI is estimated to play a transformative role in shaping the future of the financial sector, with its impact on business environments and society contingent on adherence to ethical principles [63].

AI adoption has gained significant traction in emerging markets due to its ability to enhance sustainability, profitability, and financial inclusion [64]. Nevertheless, the ethical dimensions of AI adoption present intricate challenges, including data quality, algorithmic bias, autonomy, justice, and explicability [62]. Addressing these challenges is important for building trust in AI-driven decision-making processes and ensuring equitable and transparent application [64]. To this end, the financial sector relies on robust governance mechanisms to ensure compliance with corporate governance requirements, which are essential for addressing ethical concerns [63].

It is clear that the benefits of AI adoption are improving the financial inclusion, which it emphasizes the need for decision-makers to prioritize ethical considerations in its implementation. Some studies highlight that moral issues are intrinsically tied to AI adoption, influencing its impact on the financial sector either positively or negatively, depending on the fairness and transparency of AI-generated outcome [63, 65]. Ethical considerations are complicated of challenges, such as algorithmic fairness, privacy, transparency, accountability, algorithmic bias, job displacement, security, and machine autonomy. This present significant challenges for AI adoption and the broader implementation of advanced technologies in business environments [62, 66, 67]. Upholding high ethical standards in AI adoption can enhance trust, accuracy, and fairness, yield positive socioeconomic outcomes, and foster financial inclusion. Conversely, unethical practices can adversely affect socioeconomic conditions, social life, and the economy.

4.6. Financial Inclusion

Financial inclusion refers to the ability of individuals across all income levels and genders to access financial services, such as banking accounts, credit cards, mobile banking, and other digital financial services, to support their financial needs at affordable prices [1, 68]. It can also be defined as the capacity of vulnerable members of society to use banking and obtain financial services [8, 9, 40]. Banks can enable individuals to open accounts and apply for loans by offering services that are consistent with financial soundness. Population growth pressures the financial sector to increase operational expenses and open more physical branches. However, technology development is enhanced by the launch of digitalized services and AI to assist and guide customers and present banking services at a low cost to meet all customers' needs [20, 22].

Economic growth, particularly in developing nations, faces critical challenges related to sustainability and financial inclusion [12, 60]. However, financial inclusion underscores society's right to access financial services, whereas sustainability emphasizes social, economic, and environmental concerns [12]. As a result, these issues are related to advanced technological improvements, such as big data, blockchain, Fintech, and AI, which enhance financial inclusion and increase access to financial

resources [12, 40]. This, in turn, boosts purchasing power, leading to enhanced economic growth. Furthermore, sophisticated technology mitigates the impact of environmental issues by facilitating the transition to the digital era and reducing the costs and barriers that limit access to financial services. This results in decreased financial costs, streamlined customer accounting operations, and accelerated access to customer financing [12, 40].

The development of innovations creates new business models that can provide financial services to customers and enhance financial inclusion, such as crowdfunding, P2P lending, and online platforms [39]. Consequently, new platforms have emerged to assist low-income individuals in purchasing necessities. These platforms facilitate upfront payments to businesses, allowing customers to pay the platform on a later date based on the settlement policy of a particular service provider, which supports financial inclusion. These services leverage the features of AI and big data to enhance access to financial resources, ultimately leading to economic growth. Financial inclusion is addressed by employing Tech advancements such as AI to expand the financial services sector and introduce new digital finance options, broadening the range of financial instruments available to meet community needs [56].

5. Conceptual Framework and Proposition Development

Technological advancements have advanced rapidly, leading to their integration into business. Consequently, AI adoption has become an intrinsic opportunity in the financial sectors of emerging economies. However, an analysis of the existing AI literature reveals a lack of theoretical mechanisms to illustrate the significant factors driving the AI adoption process and its effects on financial inclusion. Hence, this study proposes an initial theoretical framework grounded in theory to enhance understanding of these concepts. This provides a practical foundation for applying these theories to implement technological innovation.

Furthermore, based on the DOI theory developed by Rogers [69] which explores the new behaviours of firms in adopting technology to adapt to change, financial inclusion initiatives currently encourage the adoption of AI as a solution [70]. TOE framework developed by Tornatzky and Fleischer [71] illustrates the adoption process, providing clarity to managers, policymakers, and stakeholders regarding implementing AI innovations. Thus, integrating DOI theory with the TOE framework is able to explain well how strategic goals can shape organizations' compatibility with potential technology to maximise opportunities of adoption processing. In this study, the emergence of DOI theory and the TOE framework highlights the factors that enhance AI adoption in the financial sector of emerging economies, with organizational factors and social influence playing significant roles in driving innovation adoption, as shown in Figure 5. This study provides a sequence for implementing these innovations to achieve financial inclusion through a TOE lens. The proposed framework in Figure 5 is a unique contribution, illustrating the significant factors that drive AI and its impact on financial inclusion through the lens of DOI theory and the TOE framework. This approach clarifies the adoption process by first addressing technological readiness, followed by organizational, social influences, and ethical consideration. Integrating these factors increases the potential for organizations to adopt technological innovation.⁸

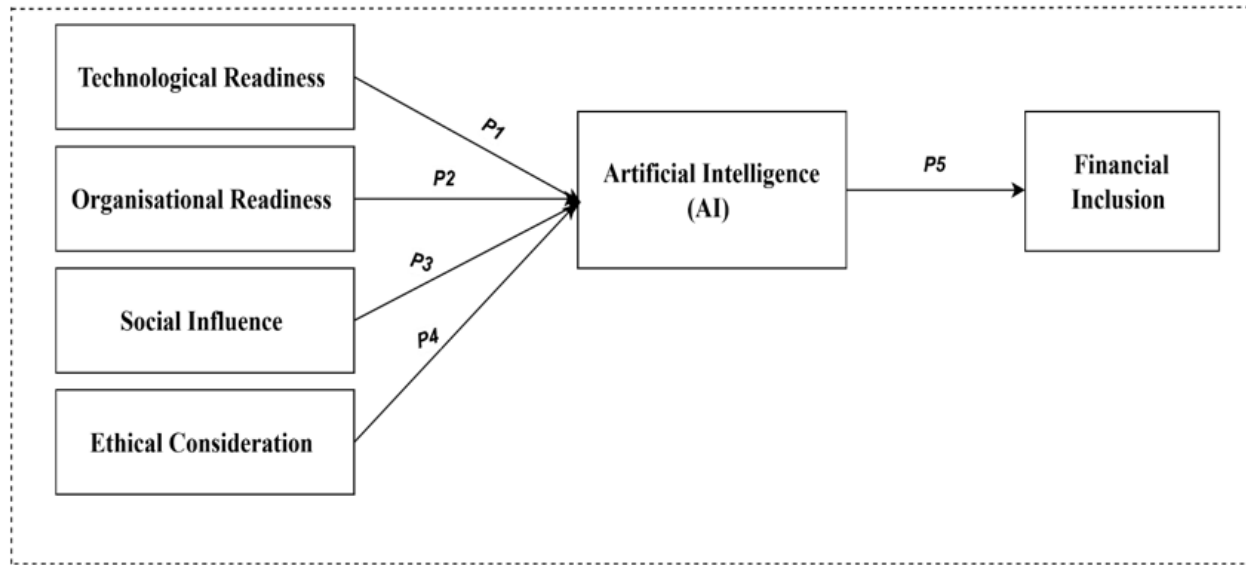


Figure 5.
Proposed framework for the Role of AI in Financial Inclusion.

This study explores the challenges of AI adoption in advancing financial inclusion by focusing on factors such as technological readiness, organizational capabilities, social trust, and ethical considerations. This emphasizes the need for sophisticated AI integration and how these factors shape the adoption process and its outcomes. Implementing the TOE model and Diffusion of Innovation theory offers valuable insights for decision-makers and policymakers, strengthening the theoretical framework, and providing practical guidance for AI implementation in financial services.

5.1. Technological Readiness and AI

Technological readiness plays a critical role for increases an organization's capability to implement technological innovation based on market needs [23]. According to some studies, including [14, 49, 51, 54] that the technology readiness has a significantly impact on the AI adoption. Furthermore, Uren and Edwards [23] found that the technological maturity enhances AI adoption to improve operations of companies. Thus, technological readiness is essential for the successful long-term adoption of AI [54]. Digital maturity encompasses the skills, knowledge, experience, and infrastructure facilitating AI implementation [21, 72]. Moreover, technological readiness includes customer acceptance of technological innovation services, which leads to increased adoption of innovations, such as AI services [49].

Nevertheless, the low readiness of the technology infrastructure complicates AI adoption, as it requires advanced technologies and data, which create barriers to successful implementation. In addition, limited technological resources increase the cost of AI adoption. Furthermore, most Tech advancements aim to implement AI at a low cost, depending on the maturity of the financial organization's capabilities [55]. Additionally, technical skills and an understanding of R&D simplify the AI adoption process. Overall, DOI theory asserts that AI innovation diffuses within firms when the advantages of the new technology exceed those of the existing technology, where AI expands financial services and creates new opportunities that increase efficiency and sustainability [54]. Technological readiness refers to trust, which increases AI adoption among firms [49]. Consequently, this study's first proposition is as follows:

P1: Technological readiness significantly drives AI adoption among financial organizations.

5.2. Organisational Readiness and AI

The degree to which an organization is prepared for change enhances its capacity to effectively implement new technologies, enabling it to seize opportunities for technical innovation and take advantage of favourable economic conditions to launch new business models [23, 54]. Numerous studies have shown that the adoption of AI in business operations and procedures is significantly influenced by organizational readiness. For example, Misra, et al. [50]; Wael AL-khatib [73] Jöhnk, et al. [54] and Pai and Chandra [51] highlighted that organizational readiness enhances new technology, such as AI adoption, which makes the organizations provide unique services to improve their effectiveness.

Organizational readiness refers to an organization's level of preparedness for acceptable change, which leads to increased technological innovation, such as the adoption of AI technologies, to enhance service channels [23, 55]. Furthermore, organizational readiness includes the readiness of managers, employees, and financial resources to implement innovations in organizational strategies to optimize their resources and take advantage of innovation to enhance operations, efficiency, profitability, and cost minimization, all of which significantly affect AI adoption [21, 55]. However, lower organizational readiness challenges financial firms to adopt AI because of limited knowledge, experience, culture, and internal and external resources. Thus, organizational readiness reflects an organization's ability to implement innovation [54]. Existing studies assert that a financial organization's capability demonstrates its power and resources for adopting AI to enhance its performance and competitiveness, adapting dynamically to environmental changes through the lens of DOI theory and the TOE framework, indicating that the organizational context significantly and positively influences AI adoption [21, 23]. Hence, based on the results of previous studies, this study's second proposition is as follows:

P2: Organizational readiness significantly and positively affects AI adoption among financial institutions.

5.3. Social Influence and AI

Several studies have indicated that social influence affects customer adoption of technological innovation. Additionally, studies by Eren [13]; Nguyen, et al. [15] and Almashhadani, et al. [6] demonstrated the critical role of social influence in fostering AI adoption, which in turn improves services and boosts consumer satisfaction. Moreover, based on previous findings, customers tend to adopt convenient services Gursoy, et al. [57]. Uren and Edwards [23] pointed out that social factors significantly influence the adoption of AI based on customer needs. Martínez-Plumed, et al. [72] suggested that successful technology adoption relies on human interaction and technological innovation. Thus, social influence plays an essential role in changing the behaviour of financial organizations to implement innovations and enhance services through various channels [6, 57]. Furthermore, Cubric [56] stated that social influence significantly drives adoption.

Financial institutions establish their reputation and stability based on society and the number of services used to enhance sustainability [51]. Notably, financial institutions do not operate in isolation from society; instead, they rely on social interactions. Consequently, social influence shapes financial organizations' strategies to meet society's needs and understand market requirements, thereby enhancing their operations by leveraging the advantages of AI Pai and Chandra [51]. Cubric [56] indicated that social influence alters financial organizations' behaviour, leading to the adoption of AI innovations based on their trust and knowledge about the advantages of AI innovation, such as financial inclusion. The results showed a significant effect of social influence on AI adoption behaviour. Therefore, based on the existing literature and the TOE framework, this study's third proposition is as follows:

P3: Social influence significantly and positively affects AI adoption among financial institutions.

5.4. Ethical Consideration and AI Adoption

AI ethics adhere to fundamental principles that play a crucial role in enhancing AI adoption. It can yield positive outcomes for financial inclusion by improving decision-making processes Khakurel, et al. [74]. According to some studies have indicated that fairness in AI systems increases the likelihood of adoption, whereas low adherence to ethical standards can result in adverse socioeconomic effects. The transparency, accountability, and legitimacy of algorithms are key factors that promote fairness in AI, significantly driving its adoption and offering solutions for financial inclusion, particularly in emerging markets [65]. Furthermore, ethical principles such as fairness, accountability, transparency, accuracy, and autonomy are critical in utilizing generative AI to enhance organizational performance Rana, et al. [66]. AI also plays a vital role in sustainability when it integrates social, economic, and environmental pillars into its framework, leading to substantial positive impacts on the financial sector [10]. This has created innovative financial models based on AI products, thereby promoting greater financial inclusion.

Moreover, AI ethics are essential for driving sustainability, particularly in emerging markets, where regulatory frameworks need to be developed to help organizations adapt to dynamic business environments [75]. By implementing ethical principles, organizations can enhance internal and external resources through AI innovation [75]. Additionally, AI ethics are shaped by organizational ethical codes and goals, ensuring justice and respect for environmental, economic, and societal rights, which results in positive societal impacts [75]. Based on the analysis of empirical outcomes from existing studies, such as those by Rana, et al. [66]; Yang and Lee [65]; Khakurel, et al. [74] the fourth proposition of this study is proposed as follows:

P4: Ethical considerations have a significantly positive effect on AI adoption among financial institutions.

5.5. Artificial Intelligence and Financial Inclusion

AI is one way to provide affordable financial services and promote financial literacy to all community members. Several studies, such as Mhlanga [9]; Aloulou, et al. [12] and Odei-Appiah, et al. [40] argue that AI drives financial inclusion. Furthermore, Adeoye, et al. [75] indicated that AI enhances financial inclusion in emerging countries. Additionally, Amnas, et al. [76] found that Fintech significantly positively affects financial inclusion. These studies highlight that technological innovation enables individuals to access a growing number of service providers.

Furthermore, technological innovation facilitates new entries into financial markets, creating new opportunities for investment and reshaping the financial model to enhance financial inclusion. Further, AI has significantly influenced the financial inclusion Mhlanga [9]. Al-Smadi [77] examined the relationship between digital finance and financial inclusion, revealing a significant effect in the Middle East and North Africa based on empirical studies using secondary data. Another study suggested that advanced technology enhances financial inclusion by providing modern services, such as ATMs, mobile banking, online platforms, online banking, and other digital financial services, thereby simplifying community access to financial services [77, 78]. Drawing from the findings of earlier research and the principle of the TOE framework, this study's fifth proposition is as follows:

P5: Artificial intelligence adoption significantly positively affects financial inclusion among financial institutions.

6. Discussion

AI is a significant research topic because it can reshape and improve financial models, customer behaviour, sustainability, and inclusion. AI is an important technological innovation that enhances financial inclusion by increasing literacy. Based on this study's bibliometric analysis, developed countries produced the highest volume of published articles on AI between 2018 and 2023, dramatically increasing the number of publications in recent years, indicating that AI is a popular topic for scientific research. Furthermore, AI optimizes the effectiveness of financial institutions by minimizing risk and improving organizational and customer relationships, thus forming new specialized markets that

strengthen the financial infrastructure serving societal needs. In addition, AI can significantly improve decentralized finance systems by fostering easy, yet highly credible, transparent interactions, as seen with P2P lending and smart contracts. It also assists in predicting credit scores and facilitates the understanding and analysis of information to assess customer risk tolerance levels. Consequently, this study presents technological readiness, which refers to the capability of financial organizations to implement AI in their operations and services.

Furthermore, social influence is a significant market factor, as it can create new market segments, leading firms to meet community needs. Consequently, financial inclusion enhances financial organizations' performance by addressing new customer needs and developing new financial instruments that can improve their profits and reputation. Therefore, managers, decision-makers, owners, and stakeholders should understand the role of AI in the financial sector and prepare their organizations to adapt to changes based on the dynamic business environment. Furthermore, AI enhances service quality, reduces associated investment risks, and enriches the knowledge of businesses, customers, and society. Additionally, implementing AI with ethical standards significantly affects financial inclusion by increasing trust in AI-generated decisions. It also provides solutions through fair decision-making and fosters more significant interaction, driving the creation of new AI products that support socioeconomic development.

DOI theory elucidates the mechanisms of interplay between technological characteristics, whereas the TOE framework clarifies how organizational and social factors significantly drive AI adoption. Furthermore, based on its credibility and traceability, AI plays a significant role in driving DeFi, thereby opening new pathways for investors to interact with financial needs without third parties or intermediaries.

AI adoption is increasing across business sectors in emerging markets. However, the financial industry face complicated challenges, such as competition, governance, and risk, faces unique challenges in providing innovative financial solutions to foster economic growth. As the global population grows, leveraging Tech advancement becomes imperative for organizations to optimize their operations and expand their services cost-effectively. Thus, emerge the AI into business operations provide opportunities to enhance efficiency and meet evolving consumer demand. In general, the discussion emphasizes the important function of AI in propelling financial inclusion as well AI's reliance on advancing technologies to solve the challenges of contemporary commercial ecosystems, expand socioeconomic opportunities and facilitate economic inclusion.

6.1. Theoretical Implications

It is clear from previous literature on AI and financial inclusion that there is a lack of theoretical conceptualization, which highlights the value of this study in clarifying the current scientific role of AI in financial inclusion. Additionally, this study establishes a proposition model integrating DOI theory and the TOE framework to develop a future research agenda to examine the factors influencing AI adoption and its outcomes in terms of financial inclusion, sustainability practices, and solutions that address societal and economic needs in emerging economies.

The adoption of AI in the financial sector is complicated and challenging for firms. DOI theory and the TOE framework were employed to elucidate the factors driving AI adoption in the financial industry and its impact on financial inclusion. This offers a comprehensive perspective on the factors that drive technological innovation and its outcomes. Therefore, this study investigates the influence of technological, organizational, social, readiness, and ethical considerations on AI adoption in emerging markets' financial institutions. This research helps to understand how these factors impact financial inclusion, which helps provide financial services to different income groups in society.

6.2. Practical Implications

This study offers valuable insights by clarifying the significant factors driving AI adoption and their impact on financial inclusion. Thereby, it also provides decision-makers, investors, stakeholders,

managers, and customers with an understanding of their technological capability, organizational readiness, ethical considerations, and the role of social influence in adopting AI in financial organizations and its consequences for financial inclusion. It also seeks to grasp the pivotal role of AI in shaping the financial landscape by enhancing organizational sustainability. Furthermore, it encourages future researchers to investigate themes related to AI and financial inclusion in emerging economies by integrating DOI theory and the TOE framework and exploring all challenges to inform actionable strategies for policymakers, financial institutions, and other stakeholders, thereby helping them harness AI's potential to address societal challenges and ensure financial access to all segments of society.

6.3. Organisational Implications

AI is emerging as a transformative force in the financial sector. It offers financial services some benefits, such as enhanced reputation, efficiency, profitability, cost reduction, expanded services, new opportunities, and financial inclusion. AI offers numerous advantages across social, economic, and sustainability dimensions. Consequently, financial institutions have significant opportunities to channel substantial investments to enhance their technological readiness. This readiness positions them as formidable solutions to financial organisations' multifaceted challenges. Additionally, AI adoption enhances financial services to serve all levels of society by reducing operational costs and increasing society's financial literacy, which enhances financial inclusion. One critical aspect of organizations is the implementation of ethical codes within AI systems to ensure the integrity of their outcomes, which provides accurate and reliable data as input. Organizations can enhance AI usage and improve the trustworthiness of their results.

6.4. Policy Implications

To foster the inclusion of AI in the financial industry, it is necessary to educate government decision makers on the importance of AI inclusion in other emerging technologies. Therefore, supporting AI and emerging technology innovation and adoption by financial institutions strategically and sustainably is imperative in addressing regulatory gaps in developing economies. Such steps are important as they guarantee the effective use of AI across the financial sector systematically. As a result, populations gain improved access to services that use AI because these services are more readily available after the application of AI-enabled solutions. Furthermore, there is an ever-increasing global population which means that adding to the existing banking facilities is essential, although it comes with considerable expenses. Financial institutions, however, need not spend much because of emerging technologies which provide them with alternatives that extend their market reach at lower costs. Governments can further catalyse AI innovation by reshaping regulations and policies and leveraging modern channels to bolster economic growth in developing nations. In addition, this study highlights that AI ethics is a critical factor in enhancing AI adoption. Addressing ethical concerns associated with AI innovations contributes to positive financial inclusion and socioeconomic development outcomes while reducing ethical risks, encouraging policymakers to develop governance roles that enhance the financial sector by implementing AI ethical standards to align with the AI revolution.

7. Conclusion

The adoption of AI represents a transformative force in the financial sector, with significant implications for financial inclusion. Therefore, AI has introduced tremendous advancements to the financial industry by offering innovative financial instruments that contribute to socioeconomic development. These advancements emphasize the sector's role in fostering social responsibility and positively impacting economic growth. As technological advancement continues to reshape the financial landscape, organizations must prioritize technological and organizational readiness to harness the full potential of AI. Furthermore, the impact of social variables emphasizes the importance of community involvement and cooperation in promoting AI use and improving financial inclusion. Integrating AI technologies into business processes aids in creating a more equitable society, while simultaneously

addressing the needs of the population. It has been established that the primary drivers for the implementation of AI in financial institutions are organizational, societal, and technological in nature. It is thus reasonable to posit that AI is beneficial for community development because it provides wider access to banking services and simultaneously decreases the number of physical branches relative to the population, thereby increasing service outlets. AI also brings important innovations in the financial sector by addressing the ethical issues of AI implementation regarding the reliability, equity, and transparency of algorithms and their results. There is a need to develop AI-enabled technologies for emerging markets as well as to modify existing regulations to foster technological innovation and aid in the cultivation of designable resources. The implementation of robust AI ethical standards has a positive impact on financial inclusion and contributes to socioeconomic and economic development. Conversely, weak enforcement of AI ethics can result in negative socioeconomic consequences and hinder broader economic progress.

Finally, the financial sector needs to reform its resource capabilities to cope with the dynamic business environment and the growth of technological innovation in the emerging economy. AI and big data can potentially increase DeFi by simplifying interactions between investors and their financial needs. Furthermore, sophisticated technologies have changed brokers' behaviour by creating P2P lending that directly facilitates the exchange of financial needs and borrowers; thus, AI enhances society's access to financial banking services and increases financial literacy.

7.1. Limitations and Future Studies

Despite the insights provided by this study, several limitations warrant consideration. First, the scope of this study is limited to a review of the existing literature, and future studies can benefit from empirical research to validate the hypotheses. Additionally, the analysis focuses primarily on the adoption of AI in the financial sector and overlooks potential barriers and challenges associated with its implementation. Subsequent investigations must delve deeper into these obstacles and identify practical approaches to address them effectively. Furthermore, although this work emphasizes the advantages of AI for financial inclusion, future research may explore any unanticipated or unfavourable effects of AI adoption. In addition, this study focused solely on the Scopus database, necessitating further research to cover more databases. Moreover, this study narrowed the keywords, encouraging future research to include ML, deep learning, DeFi, sustainability, financial literacy, and digital finance [18].

Finally, given the rapidly evolving nature of technology and financial systems, longitudinal studies are needed to track changes in AI adoption and its impact on financial inclusion over time. Overall, addressing these limitations will provide a more comprehensive understanding of the role of AI in driving financial inclusion and inform actionable strategies for policymakers, financial institutions, and other stakeholders in emerging economies. This study recommends investigating the impact of AI on DeFi because AI is a key player driving the interactions between investors and financial needs in emerging countries [18]. Furthermore, it is essential to implement the TOE framework to investigate AI and its effects on financial inclusion and organizational performance. Additionally, future studies should examine the threat of AI to financial sector employees, as AI may take over their roles. Furthermore, emerging markets need to explore the role of Industry 4.0 in achieving sustainability goals. Finally, this study recommends examining financial inclusion by comparing organizations that adopt AI with those that do not. We also encourage future research to investigate the potential negative impacts of AI (the dark side of AI) and explore the role of AI ethics in ensuring its effective implementation. Such research can help maximize the positive effects of AI on financial inclusion.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Authors' Contributions:

The first author wrote the entire final manuscript, and the second author supervised this work.

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