Article

Effect of artificial intelligence on the financial performance of Indian banking sector

Priya Rao[1,*], Nidhi Srivastava[2], Andrés Fernando Mejía-Amaya[1]

[1] Tecnologico de Monterrey, Business School, Av. Eugenio Garza Sada 2501, Monterrey 64849, Nuevo León, Mexico

[2] GL Bajaj Institute of Management and Research, Greater Noida 201306, India

* Corresponding author: Priya Rao, priyarao@tec.mx

Abstract: Purpose: The purpose of this paper is to explore the impact of Artificial Intelligence on the performance of Indian Banks in terms of financial metrics. The study focused specifically on the NIFTY Bank Index. The paper also advocates that a greater transparency in disclosing AI related information in a Bank's annual report is required even if it is voluntary. **Design/Methodology/Approach:** The paper uses a mixed method approach where quantitative and qualitative analysis is combined. A dynamic panel data model is used to understand the impact of AI of Return on Equity (RoE) of 12 Indian Banks in the NIFTY Bank Index over a five-year period. In addition to that, Content analysis of annual reports of banks was conducted to examine AI related disclosure and transparency. **Findings:** The paper highlights that the integration of Artificial Intelligence (AI) significantly influences the financial performance of sample banks of India. Return on Equity the specific parameter positively influenced with adoption of AI. The profitability of banks is positively impacted by reduced errors and improved operational efficiency. The content analysis of annual reports of the banks indicates different approach for AI disclosure where some banks give detailed information and some are not transparent about AI initiatives. The findings suggest that a higher level of transparency could enhance confidence of all stakeholders. **Theoretical Implications:** The positive relation between adoption of AI and financial performance, specifically ROE, gives a foundation for academic research to explore the dynamics of emerging technology and financial systems. The study can be extended to explore the impact on other performance indicators in different sectors. **Practical Implications:** The findings of this study emphasize the importance of transparent AI related disclosures. A detailed reporting about integration of AI helps in enhanced stakeholders' confidence in case of banking industry. The regulatory framework of banks may also consider making mandatory AI disclosure practices to ensure due accountability to maximize the benefits of AI in banking.

Keywords: artificial intelligence; Indian banking sector; financial performance; voluntary disclosure

1. Introduction

The prevailing view posits that human problem-solving and decision-making processes rely heavily on the availability of information. However, Turing (1980) in 1950, introduced a different perspective, proposing that if humans can analyze data to derive specific solutions, machines should be capable of doing the same. This marked the inception of the concept of intelligent machines. At that time, however, this idea did not gain traction due to the absence of sophisticated computational commands (Huang and Rust, 2018), as computers before 1949 lacked sufficient intelligence. Over subsequent generations, as technology advanced, the concept of

"Big Data" emerged. Today, big data is ubiquitous across a wide range of industries, including healthcare, banking, education, entertainment, marketing, and many others.

The advent of big data necessitated the development of methods to analyze and extract valuable insights from vast datasets. This led to the increasing importance of analytics, which in turn brought Artificial Intelligence (AI) to the forefront (Kok et al., 2009). It became evident that the full potential of big data could only be harnessed through the application of machine learning algorithms.

Since the turn of the 21st century, AI, big data (Guerra et al., 2023), machine learning (Wang et al., 2023), cloud computing, and blockchain technologies have gained significant momentum due to advancements in computing systems (Ratia et al., 2018) and the proliferation of big data (Haenlein and Kaplan, 2019).

Why has AI gained such rapid traction? According to the McKinsey Global Institute's 2018 report, AI applications across various industries have delivered substantial benefits, such as cost reduction, enhanced customer satisfaction, mitigation of fraudulent activities, and more efficient resource utilization.

A comprehensive AI report published by Stanford University in 2023 (Nestor et al., 2023) underscored the global investments in AI and their subsequent growth. The United States leads AI investment with $248.9 billion, followed by China at $95.1 billion, and the United Kingdom in third place with $18.2 billion. Israel, Canada, and India follow, with India ranking sixth, investing $7.73 billion in AI. Further, India ranks sixth in the deployment of machine learning systems, according to the same report. In addition to AI investments, India's economic and financial development over the last five years attracted the authors' interest in exploring AI's role in the Indian banking sector. According to Forbes (2024), India's AI market is projected to grow at a rate of 33.28% between 2023 and 2028, signaling a promising trajectory for the sector.

2. AI and the Indian banking sector

As pointed out by Alfaro et al. (2019), Jadhav et al. (2016) a number of researchers have already specified and assessed the limited use of AI in the banking industry, the fact that the banking sector is the backbone of the economy inspired the more authors to hone in on the sector as the focal area of research (Müller and Singh, 2024). Before moving forward and exploring the effect of AI on the financial performance of the banking sector in India, we must ascertain India's position with regards to AI, while also considering the development of AI in India, the present banking structure in the country and the future prospects.

India is depicting a robust pace of technological advancement amid the ongoing 3rd wave of the Internet, with an enormous investment in physical infrastructure, Unified payment interface and Digital public infrastructure. Each of these aspects has contributed significantly towards making India a "Digital India" (EMQQ, 2023). According to the World Bank and the IMF report of 2022 as quoted by Kharas (2023), the GDP growth rate of India stands at 7% and the consequent increase in middle-class consumers and the Gen Z populace is expected to prompt a hike in the consumption levels (Kharas, 2010). The Indian government's vision of fostering "Smart cities", with the objective of facilitating an optimal quality life for its citizens,

and enabling sustainability and smart solutions, is an integral step towards the large-scale integration of AI. India's deep inclination towards "Smart" technology and being digital are now positioning the nation as "The Smart- Emerging India".

With the ongoing "Smart" revolution being witnessed in the country, the financial ecosystem of India has also grown and evolved (Schipke et al., 2023). The emergence of digital money has proven to be a catalyst for the India economy, even as the public sector banks, enacting the role of financial intermediaries, remain the dominating leaders in the domestic financial milieu. In this evolving landscape, the referenced sources and studies showcase that the application of AI is gaining pace in India.

The Indian banking sector (IBEF, 2023) comprises of 12 public sector banks, 21 private sector lenders, 46 foreign banks and the widely spread urban cooperative banks, totaling 1534 in addition to 96,508 Rural Cooperative banks. Since 2016–2024, the banking sector has witnessed a CAGR of 3.34%, with the growth being dependent upon several factors like the emerging economy, an increase in disposable income, easy credit terms and documentation, increased consumerism and, above all, easy accessibility to banks (Beck and Torre, 2007; Haxby, 2024; Karlan and Morduch, 2010; Metu and Nwogwugwu, 2022). Since the last decade, the Indian banking sector is leveraging technology at an increasing pace and thereby providing error free services.

The new movement of "Digital India" can be considered a strong push towards being digital banking and a large number of payments, including those to local vendors, are now being performed digitally (Jain and Gabor, 2020; Olalere and Dorasamy, 2024). The recent trend of financial inclusion is a strong step towards financial literacy and even the Securities Exchange Board of India (SEBI) has connected its payment system to the NEFT and RTGS payment system of banks. Indeed, digital banking has even penetrated the agricultural and rural sectors of India (Kumar et al., 2023).

The available literature on India emerging as "Digital India" and the recent reforms in the banking sector, pushed the researchers to work on the impact of AI on the financial performance of India's banking sector.

3. Setting the background

3.1. Literature review

It is significant to analyze India's position in AI development, current banking structure and future prospects before assessing the impact of AI on financial performance of Indian Banks. The robust digital infrastructure of India has contributed to emergence of "Smart Digital India". To understand the role of smart technologies in evolution of financial ecosystem, it is important to discuss the efficiencies brought in by Deep learning.

Deep learning is applicable to different industries, to enhance efficient resource utilization and trigger an improvement in performance (Wang et al., 2023). The deep learning application of technology driven intervention not only brings innovation and efficiency but also accelerates the efforts towards energy efficiency (Yang and Ni, 2022). Further, the implementation of artificial intelligence or

technology driven processes helps in predicting risk with accuracy, thus facilitating the diversification of the risk by reducing information asymmetry - resulting in improved financial performance (Acemoglu and Zilibotti, 1997). It has been observed that machine learning has accelerated the use of artificial intelligence in the financial sector (Giudici et al., 2024), because of the advantage of accurate predictions, when compared to statistical models. The coverage is widespread and meets the criteria of fairness, sustainability and explainability (Weber et al., 2024). In general, these applications help financial service providers or banks develop robust IT systems, credit scoring, anti-money laundering and anomaly detection (Mishra et al., 2024).

Continuous innovations in the banking industry is the leading factor for the introduction of AI systems (Payne and O'Brien, 2024) into banking and makes banks capable of offering customized services (Fernandes and Oliveira, 2021), introducing upgraded language models for conversation (Huang and Rust, 2018), accurately interpreting the external data (Haenlein and Kaplan, 2019) and achieving objectives while being highly flexible (Manser Payne et al., 2018) and efficiently meeting customer needs (Fernandes and Oliveira, 2021) The concepts like 24 hours service, advice from experts, efficient portfolio creation, creating a profitable business model, enhancing personal wealth, among others, appear achievable (Fernandes and Oliveira, 2021) through the integration of AI systems within the banking sector.

Disclosure of AI initiatives by banks in their reports to stakeholders is important in the contemporary data driven financial system. Integration of AI in banking operations to improvise decision making, customer satisfaction and operational efficiencies calls for more disclosure by banks to build trust with the stakeholders.

To the best knowledge of the researchers, limited research has been conducted, in the past, regarding the effect of AI on the financial performance of banks.

The major financial parameters which define the financial performance of the banks, according to the BASEL committee on Banking Supervision (BCBS) are Return on Assets, Return on Equity and Net Interest Margin (Alber and Ramadan 2022; Bandyopadhyay, 2022; Duarte, 2022; Omer, 2021). Beside this, as the study is conducted on the Indian banking sector, where the Reserve Bank of India (RBI) plays the role of the central bank, we have also followed similar parameters for evaluating the financial performance of the commercial banks. A few other financial drivers have also been considered by past research and the same will be discussed further.

3.2. Banking sector and AI—A confluence

AI has sparked a revolution across various industries (Shiyyab et al., 2023), manifesting in different forms such as machine learning, cloud computing, big data, and even social media, all falling under its broad umbrella. In the modern era, AI's impact extends beyond the banking sector, influencing almost every aspect of daily life (Öztemel and Gursev, 2020). AI is driving new solutions (Shang and Zhang, 2022) through digital techniques, reducing human intervention (Tekic and Koroteev, 2019), and creating a more competitive market by expanding into areas like chatbots and robotics. AI is increasingly demonstrating its capacity as a powerful tool

(Ottosson and Westling, 2020; Purdy and Daugherty, 2016; Tákacs et al., 2018), capable of operating independently, without human support.

In the banking sector, AI has been introduced through Natural Language Processing (NLP). The use of NLP (Purdy and Daugherty, 2016; Rao and Verweij, 2017) helps banks extract relevant and necessary information from the vast amounts of unstructured data available. NLP facilitates faster knowledge transfer, making it easier to manage multiple contracts and enabling automatic contract updates. Additionally, NLP plays a crucial role in sensitivity analysis, risk management, fraud detection, and organizing unstructured documents (Ottosson and Westling, 2020).

Another significant AI application in banking is the use of chatbots—virtual assistants that provide 24/7 support to customers. These AI-powered virtual assistants are capable of addressing a wide range of queries, from simple to complex, with a high level of patience (Hwang and Kim, 2021). Services like account opening, fund transfers, and information on interest rates are readily accessible, alleviating customer stress, especially in cases of loan-related inquiries (Pant et al., 2021).

Robo-advisors represent yet another AI-driven innovation, managing investment portfolios by balancing customers' risk and return preferences. These robo-advisors (Vijai et al., 2020) continuously monitor financial markets, adjusting portfolios to meet customer requirements. Credit scoring models also leverage AI technology (Han et al., 2020) to assess customer creditworthiness, helping banks better mitigate risks. Additionally, software like Blue Prism and UiPath is widely used in daily banking operations (Vijai et al., 2020), streamlining regulatory compliance and operational efficiency.

AI plays a pivotal role in reducing fraudulent contracts and optimizing operational resources (Couchoro et al., 2021). This is achieved through technologies such as data mining, sequence alignment, and fuzzy logic (Raj and Portia, 2011). As a result, banks have significantly improved their speed of operations, accuracy, and efficiency in fraud and risk management (Kaya, 2019; Soni, 2019). AI-enabled systems allow banks to proactively detect potential fraud (Kaya, 2019), particularly through the use of Secure Socket Layer (SSL) protocols, which safeguard online transactions by providing multiple authentication permissions. Fingerprinting technology, tokenized passwords, and SSL protocols together ensure heightened security for customers' financial assets.

The introduction of AI has also led to the personalization of retail banking services (Kim et al., 2015), making banks more customer-centric. There is no doubt that AI has enhanced the operational efficiency of the banking sector (Mi Alnaser et al., 2023), and today it is critical for financial institutions to implement AI tools to meet performance expectations. AI applications in banking allow for the collection of data from various sources, and the analysis and interpretation of this data to address user-specific problems, thereby improving both operational and predictive efficiency (Kaplan and Haenlein, 2019; Xu et al., 2020).

Moreover, corporate reputation, which is often a result of a firm's overall performance (Eren, 2021), is positively influenced by AI-enabled service satisfaction in the banking sector, ultimately enhancing a bank's reputation (Mi Alnaser et al., 2023).

According to the available literature some of the visible benefits of AI for Banks are operational efficiency (Tekic and Koroteev, 2019; Vijai et al., 2020), Fraud Detection and Risk Management (Couchoro et al., 2021; Kaya, 2019), Customer Support (Hwang and Kim, 2021), Personalization (Kim et al., 2015), Data Analysis for better credit scoring (Purdy and Daugherty, 2016; Vijai et al., 2020), improvised branding of the bank (Mi Alnaser et al., 2023), freedom from routine task due to automation (Vijai et al., 2020)

3.3. AI's impact on financial performance of banking sector

Section 3.2 of this paper has already discussed the shift towards digital banking and the visible benefits of AI in the banking sector. The widespread applications of AI system like Chatbots, NLP, SSL, Robo-advisors have sped up banking services and banks have become more customer-centric, offering 24X7 availability and accessibility. Even though the disclosures on AI application, in the annual reports of banks remains completely voluntary (Folarin and Idris, 2020; Shiyyab et al., 2023), the benefits which AI unlocks for the banking sector, and the future opportunities it creates is well understood. This voluntary disclosure requirement is among the major reasons for the different levels of AI practices currently prevailing in Indian banks and the common acceptance of such practices. While sufficient literature is available on the AI front, specific research into AI and its effect on financial performance indicated limited output.

The financial performance of banks is measured through metrics including Return on Assets (ROA), Return on Equity (ROE), and Net Interest margin (NIM) (Baker et al., 2023; Manser Payne and O'Brien, 2024; Setiawan, 2021; Shiyyab et al., 2023; Xu and Xu, 2023). In the United States of America (USA), banking customers emphasized that an increased interaction of AI and humans, through interactive platforms, especially in the case of banks, resulted in greater value perception, leading to improved financial performance (Manser Payne and O'Brien, 2024). Further, the AI tools proved to be a game changer (Huang and Rust, 2018) for the banking industry, creating higher efficiencies in the long run. A variety of mandates, including compliance tasks, lending documentation and payment processing, can be undertaken though AI, thereby limiting the cost to the bank and enhancing the underlying financial performance (Königstorfer and Thalmann, 2020), thus ensuring greater profitability.

The profitability of the bank fluctuates when the artificial intelligence programs being applied are ineffective and unreliable (Setiawan, 2021). For instance, in the European financial market, the French banking sector bolstered its customer satisfaction parameters and lowered its default risk with the use of AI tools (Fraisse and Laporte, 2022; Königstorfer and Thalmann, 2020), thus enhancing its performance and achieving regulatory requirements. Separately, in Germany, the use of AI tools led to cost reduction (Finkenwirth, 2021) and an increase in the profit margin. In Asia, the Indian banking sector is rapidly adopting AI tools (Achary, 2021) and these tools are instrumental in improving the efficiency level of banks (Gupta et al., 2024) and, ultimately, customer satisfaction. AI tools improve the quality of decisions with reference to lending, credit appraisals and compliances,

leading to increased profitability (Gupta et al., 2024) and, in Jordan; the use of AI even impacted the financial performance of the banks, with regards to the ROA and ROE.

The Chinese banking sector also noticed a positive correlation (Xu and Xu, 2023) between financial performance, measured in the context of ROA and ROE and AI, owing to the underlying cost effectiveness and the positive sentiment in the market, even as the Malaysian banking sector revealed a similar ethos and remains in favor of AI tools (Omar et al., 2017) for improved financial performance.

Digital transformation (Azizjon, 2024) is the key factor, for the revenue growth and increased market share in the banking sector, when considering reasons such as innovative products, partnerships and enhancing fee-based services. Post 2008's global financial crisis, the financial service sector is now driven, to a large extent, by technological innovations. The combination of AI, blockchain, wallets and near field communication (Lim et al., 2019) has led to round-the-clock availability of services, enhancing customer satisfaction and improving financial performance.

In the United Arab Emirates (UAE), banks' financial performance in the form of ROA, ROE and net profit (Baker et al., 2023) were also affected due to the technological innovations in AI. This trend is evident not only in the developed world or the rich world, but also in other parts of the world, such as the African region, where AI is positively and significantly impacting (Folarin and Idris, 2020) the financial performance of the banking sector.

Artificial Intelligence interventions in the banking sector, along with other fintech innovations, have enhanced customer satisfaction (Liang et al., 2019) and trust, thereby resulting in better financial performance (Almulla and Aljughaiman, 2021). Thus, the literature available indicates that there exists a strong relationship among AI, mobile banking, fintech, technological innovation, internet banking, phone banking and the underlying bank's profitability, cost reduction, efficiency and productivity enhancement (Alber, 2022; OECD 2021).

3.4. Voluntary disclosure on AI or related tools: Theories and models

According to the Bank for International Settlements (BIS), "disclosure by banks" entails making market participants aware of the common risk metrics inherent in the banks. By disclosing relevant risks, banks facilitate not only the comparison of different institutions' risk profiles but also promote symmetry in information (Garcia and Mendonça, 2023).

The objective of Pillar 3 of the Basel framework, which focuses on regulatory disclosure, is to ensure market discipline. These disclosure norms provide insights into banks' risk exposure and regulatory capital. Beyond mandatory regulatory disclosures, voluntary disclosure and its implications have also gained attention (Nkwaira and Van der Poll, 2023; Oliveira et al., 2022). Concepts such as AI, machine learning, cloud computing, and big data fall under the umbrella of such voluntary disclosures. When banks go beyond Basel's regulatory requirements (Elfeky, 2017) by sharing additional information, whether financial or non-financial (Frenkel et al., 2020), in their annual reports, it constitutes voluntary disclosure. This often

involves banks narrating their success stories and voluntarily providing information beyond what is required by regulatory norms (Pandya et al., 2021).

Several theoretical frameworks support the concept of voluntary disclosure, including Agency Theory (Stephen Ross, 1973), Legitimacy Theory (Dowling and Pfeffer, 1975; Suchman, 1995), Stakeholder Theory (Laplume et al., 2008), and Signaling Theory (Connelly et al., 2011). Agency Theory emphasizes reducing agency costs and supports voluntary disclosure (Pandya et al., 2021) in annual reports. This theory posits that transparency between stakeholders (investors) and agents (executives) can be achieved through extensive disclosures. The more information disclosed, the greater the shareholders' trust in the management team, as it conveys successful measures (Wang et al., 2008).

Legitimacy Theory suggests that firms strive to build a positive image in the eyes of their stakeholders and act in ways that are deemed acceptable by society. Voluntary disclosure, in this context, is often a means to demonstrate a commitment to Corporate Social Responsibility (CSR) (Greenwood and Simmons, 2004). In the case of banks, stakeholders include shareholders, employees, creditors, society, competitors, and the media, all of whom expect banks to provide adequate information. Stakeholder Theory posits that banks should disclose information to reveal their performance and value addition for stakeholders (Laplume et al., 2008; jia Amaya, 2013). However, it can be inferred that these theories, particularly Legitimacy and Stakeholder Theories, may lead banks to disclose only favorable information, while withholding data that could negatively impact their image.

In contrast, Signaling Theory (Schleicher, 2012) contends that both voluntary and regulatory disclosures in annual reports signal the bank's performance. When managers disclose positive news, it signals strong performance and future profitability. Conversely, when negative news is disclosed, it serves as a signal of potential future losses. Voluntary disclosures, therefore, provide signals regarding anticipated profitability or losses (Campbell et al., 2003), enhancing investors' confidence (Albitar et al., 2020) and ultimately improving the bank's financial performance (Alkaraan et al., 2022).

After examining these theories, researchers concluded that Signaling Theory is the most appropriate framework for this research. To better understand how AI and related technologies impact the performance of the Indian banking sector, this study adopts Signaling Theory as its guiding principle. The theory's focus on the way disclosures—whether positive or negative— signal a bank's future performance aligns well with the research objective, particularly in assessing how AI tools influence operational efficiency and financial outcomes in banks.

4. Methodology: Variables and sources

The voluntary disclosure of AI in annual reports informs the stakeholders about the operational efficiency (Campbell et al., 2003) of the bank, in keeping with the AI tools that have been adopted. Following the signaling theory, as discussed in section 3.4, this disclosure is a signal towards positive financial performance. When banks disclose information about the technological innovations being leveraged in their functions, customers feel more secure about trusting the bank with their hard-

earned money, and creditors witness a trust enhancement owing to the utilization of proper risk management tools—the use of updated technology bolsters sensitivity analysis and depicts a proactive attitude on the part of the banks. The benefits that AI and its tools unlock for the diverse stakeholders of the banks, as well as the dependent and independent variables in consideration are being worked on.

4.1. Independent variable

This paper is an effort towards identifying the impact of AI on the financial performance of banks - The term AI does not cover just the aspect of Artificial Intelligence but also a variety of other terms which are closely related to AI. This research performed a content analysis on the annual reports of Indian banks, to measure the disclosure of AI related keywords. Once the list was prepared, all of the terms related to AI were placed under the big umbrella of AI.

The key terms which fall under this AI umbrella are defined by many professional bodies in the financial sector, including the Financial Stability Board (FSB, 2017) and The Organisation for Economic Co-operation and Development (OECD, 2023) "Machine Learning", "Big data", "Cloud" and "AI" itself.

Previous research, conducted in the USA (Manser Payne and O'Brien, 2024), France (Fraisse and Laporte, 2022), Germany (Finkenwirth, 2021), Malaysia (Omar et al., 2017), China (Xu and Xu, 2023), India (Achary, 2021), Jordan (Shiyyab et al., 2023), Africa (Folarin and Idris, 2020) considered the terms AI, machine learning, cloud, and big data under one category. Accordingly, the researchers also utilized the terms AI, cloud, machine learning and big data, and then created AI as the big umbrella and the independent variable for research.

4.2. Dependent variables

Given that the main objective of the paper is to identify the effect of AI on the financial performance of the analyzed banks, the financial performance parameters are the dependent variables in this context. The paper is specific to the banking sector, and accordingly, metrics such as ROA, ROE and Net Interest Margin have been considered as the key financial performance indicators of the banks.

All the previous researches in the USA (Manser Payne and O'Brien, 2024), France (Fraisse and Laporte, 2022), Germany (Finkenwirth, 2021), Malaysia (Omar et al., 2017), China (Xu and Xu, 2023), India (Achary, 2021), Jordan (Shiyyab et al., 2023), Africa (Folarin and Idris, 2020) on the similar theme has considered the one or other of these indicators. ROA and ROE are extremely important to all types of firms because each firm generates revenue from the assets they employ and the invested shareholder's capital. The higher the ROA (Hasan et al., 2023) and ROE (Almustafa et al., 2023), the higher is the performance of the firm.

AI has been considered as a powerful variable (Shiyyab et al., 2023) affecting the ROA and ROE. The application of AI (Soni, 2019) in banks has enhanced their process, accuracy, speed and efficiency, with predictive analytics and fraud prevention tools facilitating higher financial performance.

The third variable, which is affected by AI usage and is considered in this paper, is Net Interest Margin (NIM). The NIM is the main income from the banking operation of lending and borrowing and increased revenue and a reduction in cost directly affects the NIM. All the previous work performed on AI and bank performance results in cost reduction (Königstorfer and Thalmann, 2020). AI application in commercial banking brings cost efficiency in all core business areas. Efficiencies arising due to cost reduction, in the process of credit risk models, collateral, compliance follow-up and development of new business, help boost the revenues in double digits (Finkenwirth, 2021). AI tools which were earlier used only for cost cutting and increasing the profit margin, (Finkenwirth 2021) have now turned their focus towards the underlying growth potential.

4.3. Control variables

In this research, some control variables are also included because the researchers found them to be among the factors affecting financial performance. The type of ownership, whether Government or private, the age of the bank till the research period, and the total assets of the bank are the control variables considered here. By including these variables, the researchers consider that the bank's financial performance, following the introduction of AI tools, is a result of the ownership of the bank. The assets of the bank define their size and thus, also affect management activities and bank performance and this is the reason for this research applying the Log natural for the total assets of the bank. The physical presence of the bank is, again, an important factor for the customers and also the reason for considering the age of the bank. The age of the bank is a competitive advantage which attracts and retains the clientele, thereby leading to an increase in revenues and less credit risk to the banks.

4.4. Research data: Sample, tool, source and time frame

The researchers opted for India given that the country has depicted outstanding progress, over the last decade, and is now the fifth largest global economy. The government of India is targeting an ascension to the third largest economy in the coming years and desire that, by 2047, India should fall within the brackets of a developed nation (RBI report, 2023).

The annual reports of banks are considered as the main and most reliable source of information into the functioning of the lenders. Therefore, these reports were considered while conducting the content analysis for this research. Regarding the AI as an independent variable, the 60 annual reports, comprising of the annual reports of 12 banks over the last 5 years, became the basis of the study.

For the content analysis, the key terms of AI, including AI, cloud, machine learning and big data, were searched and the total count of these words was performed. After arriving at the sum, the percentage of AI and the related terms was calculated, in relation to the total words in the annual report.

For the financial (ROA, ROE and NIM) and control variables, the data base of Thomson Reuters, over the past 5 years (2018–2023) was leveraged. The complete data set for the sample of the NIFTY Bank Index was fetched from Thomson Reuters

and wherever gaps or missing information related to Return on Assets, Net interest margin, return on equity for either of the banks was detected, the researchers consulted the annual reports, and cross checked them to fill in all the missing information.

The data set comprises of 12 banks covered under the Nifty Bank Index of India (Nifty, 2023). These banks stocks are considered highly liquid and are the true benchmarks of the capital market performance of the Indian banks. The time frame for this research is 2018–2023 as these five years were the growing phase for India (refer section 2). Throughout these years, India was moving towards the Digital India vision, at an accelerated pace and the banking industry was increasingly utilizing and introducing AI tools for customers. One of the reports by the RBI, in 2023, clearly announced that the Indian commercial banks were taking a step forward, from AI to Gen AI. Generative AI is extremely intelligent and armed with cognitive skills akin to human beings.

After the completion of the sample data sheet, this research applied the Dynamic panel data methodology for undertaking the analysis and arriving at the conclusion. This method supported the research in avoiding endogeneity in the sample data as the variables were from the same source. This research also recognized the time variation and fact that the values of the variables could have witnessed an alteration over the time period of the research being conducted.

5. Data details, analysis and interpretation

In this section, the dependent and independent variables, the data set related to AI, and detailed analysis following the application of the Dynamic panel data is discussed. This section depicts 4 tables and covers the statistical analysis of the results.

Table 1. Research variables defined.

Variables	Variable Definitions
AI	The term Artificial Intelligence, machine learning, Cloud and Big data. These terms appear in the annual reports of the banks
ROA	Return on Assets
ROE	Return on Equity
NIM	Net Interest Margin
TA	Total Assets and Log natural calculated
Age	The age of the bank till the 2023 March since their establishment
Ownership	Government or Non Government

The dataset for **Table 1** was retrieved from Thomson Reuters. ROA, ROE, NIM, TA and date of incorporation, for the 12 banks covered under the Nifty Bank Index, was retrieved. For the TA, the log natural was calculated to understand the compounding affect. Regarding the age calculation, the banks' age was calculated till the 2019–2023 period, one by one. Whether the banks are owned by the Government or the private sector was ascertained with 0 and 1 values.

Table 2. Statistics of the % of AI and its related term.

Banks	The % of AI and its related key terms w.r.t total words in Annual Report				
Nifty Bank Index	2018–2019	2019–2020	2020–2021	2021–2022	2022–2023
AU Small Finance Bank Ltd.	0.0141%	0.0146%	0.0080%	0.0106%	0.0226%
Axis Bank Ltd.	0.014%	0.017%	0.029%	0.036%	0.034%
Bandhan Bank Ltd.	0.0013%	0.0010%	0.0065%	0.0073%	0.0083%
Bank of Baroda	0.019%	0.007%	0.001%	0.002%	0.005%
Federal Bank Ltd.	0.005%	0.005%	0.011%	0.009%	0.012%
HDFC Bank Ltd.	0.013%	0.019%	0.016%	0.020%	0.040%
ICICI Bank Ltd.	0.004%	0.003%	0.010%	0.010%	0.022%
IDFC First Bank Ltd.	0.002%	0.000%	0.012%	0.004%	0.009%
IndusInd Bank Ltd.	0.002%	0.003%	0.014%	0.010%	0.013%
Kotak Mahindra Bank Ltd.	0.0068%	0.0095%	0.0108%	0.0225%	0.0122%
Punjab National Bank	0.000%	0.000%	0.000%	0.001%	0.000%
State Bank of India	0.007%	0.010%	0.014%	0.007%	0.010%

The percentage in **Table 2** refers to the terms related to AI, in comparison with the total words in the annual report of the banks. AI tools including ChatGPT and the word count feature was highly leveraged to count the total words of the annual report and the key terms related to AI. Human intelligence is of high importance and accordingly, a human cross check was carried out to enhance the reliability of the values.

Table 3. Descriptive statistics.

	N	**Mean**	**StD**	**Min**	**perc 25**	**perc 50**	**perc 75**	**Max**
Return on Equity	60	0.09	0.10	−0.33	0.04	0.11	0.15	0.23
Return on assets	60	−0.05	0.32	−1.67	0.00	0.01	0.02	0.28
Words related to AI	60	16.33	15.60	0.00	5.50	14.00	22.00	80.00
AI words w.r.t total words in AR	60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Size (Log Assets)	60	18.10	1.29	15.37	17.02	18.34	19.02	20.40
Age (Log)	60	3.49	0.95	1.45	3.23	3.34	4.35	4.86
State owned Bank	60	0.25	0.44	0.00	0.00	0.00	0.50	1.00
State owned Bank=0	45							
State owned Bank=1	15							

Notes: i) Descriptive statistics of variables included in the models.

Analysis:

The results of **Table 3** clearly show that the ROE and ROA was significantly affected by AI. The mean values of ROE at 9% and ROA negative 5% shows that the profitability related to the shareholders equity is positive but in the case of ROA with the negative results, it is evident that bank's profitability is negative. Looking at the results of **Table 1**, we can assume the bank's assets are not being effectively used to generate profits.

The median of 11% for ROE and 1% for ROA is greater than the mean for ROE and ROA, which represents the distribution having negative asymmetries. There are some large negative extreme values affecting the form of the distribution. More clearly, the sample data results indicate that there are banks with large losses.

Regarding the disclosure on AI, the **Table 1** results show that AI is extremely shortly described in the annual reports, with an average usage of merely 16 words. When we compare the terms of AI used, with the total words in the annual reports, the result is minute. This indicates that banks are not disclosing sufficient information about the application of AI in their annual reports. The sample sheet and even **Table 1** clearly show that non-government banks are more transparent when compared with the government banks.

Table 4. Dynamic data panel model estimations dependent variable: ROEit.

	(1)	(2) Interacting with age
ROEi, t−1	0.517 ***	0.638 ***
	(0.108)	(0.109)
AI words w.r.t total words in AR$_{it}$	283.062 **	2455.623 ***
	(124.358)	(800.923)
Size (Log Assets) it	−0.028	−0.028 *
	(0.019)	(0.016)
Age (Log) it	0.035 *	0.072 ***
	(0.018)	(0.021)
AI proportion X Firm age$_{it}$		−665.406 ***
		(239.657)
Intercept	0.401	0.283
	(0.288)	(0.246)
Number of observations	48	48
Number of AR tests	0	0
x^2	32.828	49.181
Sum of squared differenced residuals	0.263	0.233
Sargan statistic	46.726	45.174
Estimate of $(\sigma\_\varepsilon)^2$	0.004	0.004

Notes: i) significance stars: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. ii) Models 1 and 2 are dynamic data panel regressions on ROE$_{it}$ as dependent variable. iii) Model 2 incorporates an interaction term between age and the AI words' proportion on the annual reports.

Analysis:

Looking at the results of **Table 4**, and considering the results of model 1, the positive effect of the proportion of AI terms on the return on equity clearly indicates an increase of 1% in the proportion of AI words, in relation to the total size or the total words of annual reports, with the ROE consequently increasing by 2.83% on an average. The impact of the lag on contemporary ROE is significant and positive, as expected, because in the dynamic panel the autocorrelations of order 1 are present. A similar effect is also visible in Model 2 of **Table 4**. This significant and positive effect implies that the usage of artificial intelligence key terms in the annual report is offering

benefits to the banks' shareholders, in the research sample. On the other hand, control variables such as size and age do not demonstrate the expected results, as in other studies. It is mainly explained by the special characteristics of the bank sector and the market we studied, so age demonstrates a positive effect. Size is negative, but weakly significant in model 2. So, model 2 expands the analysis by including an interaction term between age and the proportion of AI words in reports. This negative and significant coefficient, jointly with the positive effect of the single variable, implies that, for older banks, innovation in AI does not improve return on equity as much as it does for the younger ones. But to confer, both model 1 and 2 show the wellness of adjustment to the sample, and to the estimation process.

6. Conclusion, recommendation and future scope

This research work was revolving around identifying the effect of AI on the financial performance of the banks. The analysis and the interpretation of the statistical results confirm that there do exist the relation between the AI and ROE of the banks. While discussing on the AI, as a voluntary disclosure this research supports (Mushtaq et al., 2022) who argued that corporate disclosures are helpful in assessing and predicting a firm's performance. This research also agrees that the information which is disclosed in the annual reports of the banks are the true signals of their financial performance (Baker et al., 2023) even though the emphasis was only on the AI and its related terms. The results of ROE in relation with AI supports that the more the information disclosed on AI in the annual reports, not only communicates successful measures but also increases shareholders' trust in the management team (Wang et.al, 2008) and also coveys that application of technology driven intervention bring innovation efficiency and leads to the accelerated results (Folarin and Idris, 2020). The results of **Table 4** with 2.83% increase in ROE value getting affected by the AI clearly indicates that implementation of artificial intelligence or technology driven processes helps in predicting risk with accuracy further resulting in improved financial performance and generating the trust of shareholders in the banks. The positive relationship within ROE and AI also supports the strategic point of view leading to better financial performance and value creation (Hasan et al., 2023; OECD, 2021).

This research also concludes that the age of the banks that is the incorporation year is of least importance, whether the bank is newly established, or it has existed for a long time; the disclosure on AI matters and more and more information on AI needs to be disclosed in the annual reports. With time, the banking operations have improved with adoption of various application of AI (Hasan et al., 2023; OECD, 2021) and it is essential today to implement these tools for any financial institution to meet the expected performance. The base of this research was the signaling theory, the researchers agree on the basis of the results of the sample data that the more application of the AI in the banks and the more disclosure in the annual reports about the AI, will have a positive impact (Frenkel et al., 2020; Wang et al., 2008) on the ROE of the banks. Hence AI has been found a significant signal affecting the RoE.

Just like most of the research, this research also holds the limitation of time frame that is the data is covered only for five years and secondly this research is limited to only the banks listed on Nifty Bank Index. However, these limitations do not detract

from the findings, as the Nifty Banks represent the broader banking sector in India's capital markets.

Finally, we the researchers agree on the impact of AI and other related technological innovations have started reaping benefits in the banking sector and innovative services and products are floated in the market to customers, but the sky has no limits. The opportunities lie ahead and the challenge like strong infrastructure is required in the banks for the proper application of AI models. The black box aspect of AI, which is difficult to decode is again a challenge. The banks need to be extremely careful with AI models in the case of data drift, bias predictions and unexpected behavior. Data privacy and cybersecurity can pose challenges related to governance. The researchers suggest that if the banks overcome these challenges, the chances are that the more information on AI will be disclosed in the annual reports and the effect of AI will start providing the strong signals towards the financial performance indicators.

The research is of extreme importance to the financial sector of India and other countries as it clearly inform how the AI affects the financial performance. It is also relevant for AI developers, as it highlights areas where AI tools can be improved, and for governments, which need to provide appropriate infrastructure for the implementation of AI tools. Above all, it emphasizes the importance for banks to disclose AI-related information in their annual reports to enhance stakeholder confidence and to support the publicly available information.

Finally, this research offers a foundation for future studies, encouraging researchers to consider additional indicators with the terms of AI, wider controllable variables over a longer time frame and explore cross-country comparisons

Author contributions: Conceiving, collecting and analyzing the data, writing the article, PR; conceiving, collecting, and analyzing the data, writing the article, NS, conceiving, collecting, and analyzing the data, writing the article, AFMA. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

References

Acemoglu, D., &Zilibotti, F. (1997). Was Prometheus unbound by chance? Risk, diversification, and growth. Journal of political economy, 105(4), 709-751.

Achary, R. (n.d.). Artificial Intelligence Transforming Indian Banking Sector. http://www.iaras.org/iaras/journals/ijems Achary, R. (2021). Artificial intelligence transforming indian banking sector. International Journal of Economics and Management Systems, 6.

Alber, N., & Ramadan, H. (2022). The Effect of Applying Banking Regulations on Banking Performance of MENA Region Countries. European Journal of Business and Management Research, 7(1), 170–185.https://doi.org/10.24018/ejbmr.2022.7.1.1258

Albitar, Khaldoon, Khaled Hussainey, Nasir Kolade, and Ali Meftah Gerged. 2020. ESG disclosure and firm performance before and after IR. International Journal of Accounting & Information Management 28: 429–44.

Alfaro, Elena, Bressan, Marco, Girardin, Fabien, Murillo, Juan, Someh, Ida, Wixom, Barbara H., 2019. Bbva's data monetization journey. MIS Q. Exec. 18 (2).

Alkaraan, Fadi, Khaldoon Albitar, Khaled Hussainey, and Vg Venkatesh. 2022. Corporate transformation toward Industry 4.0 and financial performance: The influence of environmental, social, and governance (ESG). Technological Forecasting and Social Change 175: 121423.

Almulla, D., & Aljughaiman, A. A. (2021). Does financial technology matter? Evidence from an alternative banking system. Cogent Economics and Finance, 9(1). https://doi.org/10.1080/23322039.2021.1934978

Almustafa, Hamza, Quang Khai Nguyen, Jia Liu, and Van Cuong Dang. 2023. The impact of COVID-19 on firm risk and performance in MENA countries: Does national governance quality matter? PLoS ONE 18: e0281148.

Azizjon, K. (2024). Unconventional approaches to enhancing commercial banks' revenue streams. International Journal of Advance Scientific Research, 4(3), 219–225. https://doi.org/10.37547/ijasr-04-03-40

Baker, H., Kaddumi, T. A., Nassar, M. D., & Muqattash, R. S. (2023). Impact of Financial Technology on Improvement of Banks' Financial Performance. Journal of Risk and Financial Management, 16(4). https://doi.org/10.3390/jrfm16040230

Bandyopadhyay, A. (2022). Bank Financial Performance and its Linkage with Capital: A Dynamic Panel Data Analysis of Public Sector Banks in India. The Indian Economic Journal, 70(3), 437-451. https://doi.org/10.1177/00194662221104752

Beck, T. H. L., & de La Torre, A. (2007). The basic analytics of access to financial services. Financial Markets, Institutions and Instruments, 16(2), 79-117. https://doi.org/10.1111/j.1468-0416.2007.00120.x

Bonsón, E., & Bednárová, M. (2013). Corporate LinkedIn practices of Eurozone companies. Online Information Review, 37(6), 969-984. https://doi.org/10.1108/OIR-09-2012-0159

Bonsón, E., Lavorato, D., Lamboglia, R., & Mancini, D. (2021). Artificial intelligence activities and ethical approaches in leading listed companies in the European Union. International Journal of Accounting Information Systems, 43, 100535. https://doi.org/10.1016/j.accinf.2021.100535

Campbell, David, Barrie Craven, and Philip J. Shrives. 2003. Voluntary social reporting in three FTSE sectors: A comment on perception and legitimacy. Accounting, Auditing & Accountability Journal 16: 558–81.

Connelly, B. L., Certo, S. T., Ireland, R. D. and Reutzel, C. R., (2011). Signaling Theory: A Review and Assessment. Journal of Management, 37(1), 39–67

Couchoro, Mawuli K., Koffi Sodokin, and Moubarak Koriko. 2021. Information and communication technologies, artificial intelligence, and the fight against money laundering in Africa. Strategic Change 30: 281–91

De Oliveira, K.V., Lustosa, P.R.B., Freire, F.d.S. and de Carvalho, F.A. (2022), "Antecedents of CSR disclosure in an emerging economy: evidence from the banking industry", Journal of Accounting in Emerging Economies, Vol. 12 No. 1, pp. 97-126. https://doi.org/10.1108/JAEE-10-2020-0257

Dowling, J., Pfeffer, J., (1975). Organizational Legitimacy: Social Values and Organizational Behavior. Pacific Sociological Review, 18(1), 122–136.

Duarte, J. M. (2022). The impact of Basel III on the return on equity of the European banking sector [Dissertação de mestrado, Iscte - Instituto Universitário de Lisboa]. RepositórioIscte. http://hdl.handle.net/10071/26701

Elfeky, M. I. (2017). The extent of voluntary disclosure and its determinants in emerging markets: Evidence from Egypt. Journal of Finance and Data Science, 3(1–4), 45–59. https://doi.org/10.1016/j.jfds.2017.09.005

Emqq goes: On the ground research India September 2023 , EMQQ Global Research

Eren, B.A. (2021), "Determinants of customer satisfaction in chatbot use: evidence from a banking application in Turkey", International Journal of Bank Marketing, Vol. 39 No. 2, pp. 294-311. https://doi.org/10.1108/IJBM-02-2020-0056

Finkenwirth, K. (2021). The Impact of Artificial Intelligence on Financial Performance in the German Financial Service Industry—A Content Analysis. Working Paper. Available online: https://run. unl.pt/bitstream/10362/122610/1/2020-21_fall_41614_ katharina-finkenwirth. pdf (accessed on 30 April 2024).

Folarin, A., & Idris, O. (2020). Effects of Artificial Intelligence on Business Performance in the Banking Industry (A Study of Access Bank Plc and United Bank for Africa-Uba). 22, 41–49. https://doi.org/10.9790/487X-2205044149

Fraisse, H., & Laporte, M. (2022). Return on investment on artificial intelligence: The case of bank capital requirement. Journal of Banking and Finance, 138. https://doi.org/10.1016/j.jbankfin.2022.106401

Frenkel, S., Guttman, I., & Kremer, I. (2020). The effect of exogenous information on voluntary disclosure and market quality. Journal of Financial Economics, 138(1), 176–192. https://doi.org/10.1016/j. jfineco.2020.04.018

FSB. 2017. Artificial Intelligence and Machine Learning in Financial Services: Market Developments and Financial Stability Implications. Available online: https://www.fsb.org/wp- content/uploads/P011117.pdf (accessed on 16 May 2023)

Garcia, M. T. M., & de Mendonça, F. C. (2023). Compliance with the Basel Core Principles and supervisory structure: Across-country analysis. Central Bank Review, 23(2), 100117.https://doi.org/10.1016/j.cbrev.2023.100117

Giudici, P., Centurelli, M., & Turchetta, S. (2024). Artificial Intelligence risk measurement. Expert Systems with Applications, 235.https://doi.org/10.1016/j.eswa.2023.121220

Greenwood, M., Simmons, J., (2004). A Stakeholder Approach to Ethical Human Resource Management. Business & Professional Ethics Journal, 23 (3), 3–23.

Guerra, J.M.M., Danvila-del-Valle, I., Su´arez, M.M., 2023. The impact of digital transformation on talent management. Technol. Forecast. Soc. Change 188, 122291.

Gupta, M., Garg, N., Jain, N., Saini, P., Roy, S., & Sati, M. (n.d.). International Journal of Intelligent systems and applications in engineering Analysis of Financial Performance Pre and Post Use of Artificial Intelligence Applications Via CAMELS Lens: With Special Reference to HDFC Bank. In Original Research Paper International Journal of Intelligent Systems and Applications in Engineering IJISAE (Vol. 2024, Issue 5s). www.ijisae.org

Han, Jingguang, Yuyun Huang, Sha Liu, and Kieran Towey. 2020. Artificial intelligence for anti-money laundering: A review and extension. Digital Finance 2: 211–39

Hasan, Fakhrul, Mary Fiona Ross Bellenstedt, and Mohammad Raijul Islam. 2023. The impact of demand and supply disruptions during the Covid-19 crisis on firm productivity. Global Journal of Flexible Systems Management 24: 87–105.

Haxby, A. (2024). Financing a Middle Class Utopia: Income and Retail Loans in Kathmandu. Anthropological Quarterly 97(2), 285-310.https://doi.org/10.1353/anq.2024.a929490

Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. Journal of service research, 21(2), 155-172.https://doi.org/10.1177/1094670517752459

Implementation to Date. EU Monitor. Deutsche Bank Research. Available online: https://www.dbresearch.com/PROD/RPS_ENPROD/Artificial_intelligence_in_banking%3A_A_lever_for_pr/RPS_EN_DOC_VIEW.calias?rwnode=PROD0000000000435631&Prod Collection=PROD0000000 000495172 (accessed on 23 May 2023).

Indian Brand Equity Foundation (IBEF) 2023, "Banking Sector in India" https://www.ibef.org/industry/banking-india

Jadhav, Swati, He, Hongmei, Jenkins, Karl W., 2016. An academic review: applications of data mining techniques in finance industry. In 2321–404X.

Jain, S., & Gabor, D. (2020). The rise of digital financialisation: The case of India. New political economy, 25(5), 813-828.https://doi.org/10.1080/13563467.2019.1708879

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. Business horizons, 62(1), 15-25.

Karlan, D., & Morduch, J. (2010). Access to finance. In Handbook of development economics (Vol. 5, pp. 4703-4784). Elsevier. Available at https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=6eef0be268b848f644c1c26bada253b 421021eee

Kaya, Orçun. 2019. Artificial Intelligence in Banking: A Lever for Profitability with Limited

Kharas, H. (2010), "The Emerging Middle Class in Developing Countries", OECD Development Centre Working Papers, No. 285, OECD Publishing, Paris,https://doi.org/10.1787/5kmmp8lncrns-en

Kharas, H. (2023). The Rise of the Global Middle Class: How the Search for the Good Life Can Change the World. Brookings Institution Press. Available at https://books.google.co.in/books?hl=en&lr=&id=XanREAAAQBAJ&oi=fnd&pg=PR3&dq=According+to+the+World+Bank+and+the+IMF+report+of+2022,+the+GDP+growth+rate+of+India+stands+at+7%25+and+the+consequent+increase+in+middle-class+consumers&ots=P1E6vAiMIo&sig=HnmVBXX2aNywAOJIbkcMUsnwCnA&redir_esc=y#v=onepage&q&f=false

Kok, J. N., Boers, E. J., Kosters, W. A., Van der Putten, P., & Poel, M. (2009). Artificial intelligence: definition, trends, techniques, and cases. Artificial intelligence, 1(270-299), 51.

Königstorfer, F., & Thalmann, S. (2020). Applications of Artificial Intelligence in commercial banks – A research agenda for behavioral finance. Journal of Behavioral and Experimental Finance, 27. https://doi.org/10.1016/j.jbef.2020.100352

Kumar, M. S., Upadhyay, M. M., &Srivastava, N. (2023). Financialinclusion. Vidhyayana-An International Multidisciplinary Peer-Reviewed E-Journal-ISSN 2454-8596, 8(si5), 98-115.

Kute, Dattatray Vishnu, Biswajeet Pradhan, Nagesh Shukla, and Abdullah Alamri. 2021. Deep Learning and Explainable Artificial Intelligence Techniques Applied for Detecting Money Laundering–A Critical Review. IEEE Access 9: 82300–17.

Laplume,A. O., Sonpar, K. and Litz, R. A., (2008). Stakeholder Theory: Reviewing a Theory That Moves Us. Journal of Management, 34(6), 1152–1189.

Liang, C. J., Wang, W. H., & Dawes Farquhar, J. (2009). The influence of customer perceptions on financial performance in financial services. International Journal of Bank Marketing, 27(2), 129-149. https://doi.org/10.1108/02652320910935616

Lim, S. H., Kim, D. J., Hur, Y., & Park, K. (2019). An empirical study of the impacts of perceived security and knowledge on continuous intention to use mobile fintech payment services. International Journal of Human–Computer Interaction, 35(10), 886-898. https://doi.org/10.1080/10447318.2018.1507132

Magness, V. (2006). Strategic posture, financial performance and environmental disclosure: An empirical test of legitimacy theory. Accounting, Auditing & Accountability Journal, 19(4), 540-563. https://doi.org/10.1108/09513570610679128

Manser Payne, E. H., & O'Brien, C. A. (2024). The search for AI value: The role of complexity in human-AI engagement in the financial industry. Computers in Human Behavior: Artificial Humans, 2(1), 100050.https://doi.org/10.1016/j.chbah.2024.100050

McKinsey Global Institute, 2018. Notes from the AI frontier: Modeling the impact of AI on the world economy.https://www.mckinsey.

Mejia Amaya,A. F. (2013). The capital structure in the company: its contemporary study. RevistaFinanzas y Política Económica, 5(2), 141-160.

Metu, A. G., &Nwogwugwu, U. C. C. (2022). Challenging Factors Affecting Access to Finance by Female Micro Entrepreneurs inAnambra State, Nigeria. Journal of African Business, 25(1), 142–154. https://doi.org/10.1080/15228916.2022.2064677

MiAlnaser, F., Rahi, S., Alghizzawi, M., &Ngah, A. H. (2023). Does artificial intelligence (AI) boost digital banking user satisfaction? Integration of expectation confirmation model and antecedents of artificial intelligence enabled digital banking. Heliyon, 9(8). https://doi.org/10.1016/j.heliyon.2023.e18930

Mishra,A.K., Tyagi,A.K., Arowolo, M.O. (2024). Future Trends and Opportunities in Machine Learning and Artificial Intelligence for Banking and Finance. In: Irfan, M., Muhammad, K., Naifar, N., Khan, M.A. (eds) Applications of Block Chain technology and Artificial Intelligence. Financial Mathematics and Fintech. Springer, Cham.https://doi.org/10.1007/978-3-031-47324-1_13

Müller, M.H.P., Singh, S. (2024). Evolution of India's Financial System – The Backbone of Transformation. In: Müller, M.HP. (eds) Indienim 21. Jahrhundert − Auf dem Weg zurpostindustriellenÖkonomie. Ökonomien und Gesellschaftenim Wandel. Springer Gabler, Wiesbaden. https://doi.org/10.1007/978-3-658-43014-6_7

Mushtaq, R., Gull,A. A., Shahab, Y., & Derouiche,I. (2022). Do financial performance indicators predict 10-K text sentiments? An application of artificial intelligence. Research in International Business and Finance, 61.https://doi.org/10.1016/j.ribaf.2022.101679

Nestor Maslej, Loredana Fattorini, Erik Brynjolfsson, John Etchemendy, Katrina Ligett, Terah Lyons, James Manyika, Helen Ngo, Juan Carlos Niebles, Vanessa Parli, Yoav Shoham, Russell Wald, Jack Clark, and Raymond Perrault, "The AI Index 2023 Annual Report," AI Index Steering Committee, Institute for Human-Centered AI, Stanford University, Stanford, CA, April 2023.

Nifty bank report October (2023) https://www.niftyindices.com/indices/equity/sectoral-indices/nifty- bank

Nkwaira, C., & Van derPoll, H. M. (2023). Anticipating the Unforeseen and Expecting the Unexpected: Effectiveness of Macro-Prudential Policies in Curbing the Impact of Stranded Assets in the Banking Sector. Risks, 11(5), 87.https://doi.org/10.3390/risks11050087

OECD. 2021. Artificial Intelligence, Machine Learning, and Big Data in Finance. Available online: https://www.oecd.org/finance/ financial-markets/Artificial-intelligence-machine-learning-big-data-in- finance.pdf (accessed on 23 May 2023).

Olalere, O. E., &Dorasamy, N. (2024). Perspectives On Digitization And Economic Growth In India. Journal of Namibian Studies: History Politics Culture, 40, 464-499. https://doi.org/10.59670/yntcfh03

Omar, S. A., Hasbolah, F., &Ulfah, M. Z. (2017). The diffusion of artificial intelligence in governance of public listed companies in Malaysia. International Journal of Business, Economics and Law, 14(2), 1-9.

Omer, A. M. R. (2021). The impact of the Basel III committee decisions on the performance of banks in Iraq. International Journal Of Economics And Finance Studies, 13(2), 477-499.

Ottosson, Frida, and Martin Westling. 2020. Artificial Intelligence and its Breakthrough in the Nordics: A Study of the Relationship between AI Usage and Financial Performance in the Nordic Market (Dissertation). Available online:https://umu.diva-portal.org/smash/record.jsf?pid=diva2%3A1446023&dswid=2794(accessed on April 27, 2024)

Öztemel, Ercan, and Samet Gursev. 2020. Literature review of Industry 4.0 and related technologies. Journal of Intelligent Manufacturing 31: 127–82

Pandya, B., & Rao, P. (2021). Human resources knowledge disclosure by leading banks: cases from KSA. Polish Journal of Management Studies, 23(2).

Park, M. S., Son, H., Hyun, C., & Hwang, H. J. (2021). Explainability of machine learning models for bankruptcy prediction. Ieee Access, 9, 124887-124899. doi: 10.1109/ACCESS.2021.3110270.

Plastino, E., & Purdy, M. (2018). Game changing value from Artificial Intelligence: eight strategies. Strategy & Leadership, 46(1), 16-22.https://doi.org/10.1108/SL-11-2017-0106

Raj, S. Benson Edwin, and A. Annie Portia. 2011. Analysis on credit card fraud detection methods. Paper presented at International Conference on Computer, Communication and Electrical Technology (ICCCET), Tirunelveli, India, March 18–19; pp. 152–56. Available online: https://api.semanticscholar.org/CorpusID:41966176 (accessed on 20 June 2023).

Ratia, M., Jussi Myllärniemi, and Nina Helander. 2018. Robotic process automation-creating value by digitalizing work in the private healthcare. In Paper presented at Mindtrek '18: Proceedings of the 22nd International Academic Mindtrek Conference, Tampere, Finland, October 10–11; pp. 222–27.

Ross, S. A. (1977). The Determination of Financial Structure: The IncentiveSignalling Approach. The Bell Journal of Economics, 8(1), 23–40.

Sadok, H., Sakka, F., & El Maknouzi, M. E. H. (2022). Artificial intelligence and bank credit analysis: A review. Cogent Economics and Finance, 10(1).https://doi.org/10.1080/23322039.2021.2023262

Schipke, M. A., Turunen, M. J., Choueiri, M. N., & Gulde, M. A. M. (Eds.). (2023). India's Financial System: Building the Foundation for Strong and Sustainable Growth. International Monetary Fund. India Brand Equity Foundation (IBEF) 2023

Schleicher, T. (2012). When is good news really good news? Accounting and Business Research, 42(5), 547–573.https://doi.org/10.1080/00014788.2012.685275

Shiyyab, F. S., Alzoubi, A. B., Obidat, Q. M., &Alshurafat, H. (2023). The Impact of Artificial Intelligence Disclosure on Financial Performance. International Journal of Financial Studies, 11(3). https://doi.org/10.3390/ijfs11030115

Soares, M. (n.d.). Title: The impact of Artificial Intelligence on financial performance in the German financial service industry-A content analysis.

Soni, V. D. (2019). Role of artificial intelligence in combating cyber threats in banking. International Engineering Journal For Research & Development, 4(1), 7-7.

Suchman, M. C. (1995). Approaches and Strategic Managing Legitimacy. Academy of Management Review, 20(3), 571–610. https://journals.aom. org/doi/abs/10.5465/AMR.1995.9508080331

Tákacs, Árpad, Imre Rudas, Dominik Bösl, and Tamas Haidegger. 2018. Highly Automated Vehicles and Self-Driving Cars [Industry Tutorial]. IEEE Robotics & Automation Magazine 25: 106–12.

Tekic, Zeljko, and Dmitry Koroteev. 2019. From disruptively digital to proudly analog: A holistic typology of digital transformation strate-gies. Business Horizons 62: 683–93.

Turing, A. M. (1980). Computing Machinery and Intelligence. Creative Computing, 6(1), 44-53.

Vijai, C., S. M. Suriyalakshmi, and MasilamaniElayaraja. 2020. The Future of Robotic Process Automation (RPA) in the Banking Sector for Better Customer Experience. Shanlax International Journal of Commerce 8: 61–65.

Vimal Pant, Nidhi Srivastava, Tejinderpal Singh and Prachi Pathak (2021). Education loan delivery by banks in India: A qualitative enquiry. Banks andBank Systems, 16(4), 125-136. doi:10.21511/bbs.16(4).2021.11

Wang, J., Wang, K., Dong, K., & Zhang, S. (2023). Assessing the role of financial development in natural resource utilization efficiency: Does artificial intelligence technology matter? Resources Policy, 85.https://doi.org/10.1016/j.resourpol.2023.103877

Wang, K., Sewon, O., & Claiborne, M. C. (2008). Determinants and consequences of voluntary disclosure in an emerging market: Evidence from China. Journal of International Accounting, Auditing and Taxation, 17(1), 14-30.https://doi.org/10.1016/j.intaccaudtax.2008.01.001.

Weber, P., Carl, K. V., & Hinz, O. (2024). Applications of explainable artificial intelligence in finance— a systematic review of finance, information systems, and computer science literature. Management Review Quarterly, 74(2), 867-907.https://doi.org/10.1007/s11301

Xu, Q., & Xu, C. (2023). The Impact of Artificial Intelligence Strategy on Corporate Financial Performance—An Empirical Analysis Based on Listed Companies Panel Data (pp. 365–371). https://doi.org/10.2991/978-94-6463-010-7_38

Xu, Y., Shieh, C. H., van Esch, P., & Ling, I. L. (2020). AI customer service: Task complexity, problem-solving ability, and usage intention. Australasian marketing journal, 28(4), 189-199.

Yang, L., & Ni, M. (2022). Is financial development beneficial to improve the efficiency of green development? Evidence from the "Belt and Road" countries. Energy Economics, 105, 105734. https://doi.org/10.1016/j.eneco.2021.105734

Zhang, Z., Wu, C., Qu, S., & Chen, X. (2022). An explainable artificial intelligence approach for financial distress prediction. Information Processing and Management, 59(4). https://doi.org/10.1016/j.ipm.2022.102988