The Application of Artificial Intelligence in Bank: Credit and Risk Management

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Abstract. Affected by the economic downturn in the post-COVID-19 period, global economic efficiency has experienced a notable decline. As a cornerstone of the financial sector and a primary point of contact for customers, banks have particularly felt the impact, with their profitability showing a marked decrease. Despite these challenges, the leapfrog development of artificial intelligence (AI) technology has opened new possibilities. More and more professionals in the banking industry, along with academic researchers, have started to explore and recognize the potential of AI applications in the financial sector. While AI's role in areas such as financial planning, automation, and customer service has been extensively studied, there is still a significant lack of research focused on its specific application in credit risk and market risk management. This paper seeks to address this gap by providing a comprehensive review of AI's development, examining its current and future potential to transform credit and risk management practices in banks. Through the integration of AI, banks can enhance decision-making accuracy, improve risk prediction models, and optimize overall financial performance, offering promising solutions to mitigate the challenges posed by the current economic climate.

Keywords: Artificial Intelligence; Bank; Credit; Risk Management.

1 Introduction

During recent years, the decline in bank financial efficiency has become one of the significant challenges facing the financial industry. There are many factors which are interweave with each other and affect the operation and profitability of the banks around the world. From the perspective of the world's macroeconomic environment, one of the most important external factors of the decline efficiency is that the growth of the global economic is sluggish after the years of the 2022. For example, because of the international trade friction between countries, or the geopolitical tensions such as the Russia-Ukraine War, and public health events have had a huge impact on the global economy [1]. It is well known that banks act as financial intermediaries globally, and the business scale or actual earnings of the banks are closely related to the activity of its real economy, so that under the influence of the impact that is mentioned above, the

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most corporate profits have weakened while the household income growth has slowed and the demand for credit have weakened. Meanwhile, during the downturn of the global economic, the repayment capacity of borrowing firms or people diminishes, resulting in a significant increase in the credit risk faced by banks and a rise in the non-performing loan ratio, which greatly erodes profits. AI technology, with its data processing and predictive capabilities, provides a promising solution to mitigate these risks. By analyzing large datasets, AI can assist banks in predicting market trends, assessing creditworthiness, and enhancing decision-making processes. To fully realize the potential of AI in financial risk management, collaboration between financial institutions, data scientists, and regulatory bodies is essential. This cross-disciplinary approach can ensure that AI models are designed with both technical rigor and regulatory compliance in mind, fostering greater trust and acceptance in the financial industry. Therefore, the overall income of banks is in a downward trend. Of course, another key factor of the influence of the bank benefit decline is the interest rate liberalization [2]. And with the revolution of the interest rate liberalization reform, on the one hand, the fluctuation of the interest rates of the market will be more flexible, and the banks face the increase of the indeterminacy which is about the cost of accessing capital, especially when market liquidity is tight, the banks should raise the interest rates to attract capital, however, the loan interest rates cannot be raised due to market competition; on the other hand, there are more and more companies and individuals are tend to adopt the issuance of bonds, stocks or other ways to equity trading, in return, it has decrease the dependence on indirect financing from banks, and both of these two aspects have led to a gradual narrowing of bank spreads.

For the past few years, the innovation of global scientific and technological has entered a period of intense activity under the rapid development of big data, information technology and biotechnology [3]. Among these high technologies, artificial intelligence stands out, particularly in recent years, as it has made significant leaps in development. Notable examples include GPT in the United States and DEEPSEEK in China, both of which have emerged one after another. AI tools are becoming more popular in numerous fields and research domains due to their quick development and efficiency [4]. At the same time, there are a lot of the "AI+" intelligent risk management model which was developed by the financial workers provide the technical support for the transformation and upgrading of banks to intelligence. Artificial intelligence represents an advanced intelligent information processing system. By enhancing the efficiency of data generation, processing, and integration, AI holds the potential to drive profound transformation within the financial industry [5]. Since AI has the characteristic of intelligence, strong information integration capacity and high accuracy, there are more and more bankers begin to use AI or the algorithm platform based on AI as the underlying logic to help them to complete work tasks. For example, with the help of AI, bankers can quickly access to the data of transaction or customer information, and then, based on AI's own machine learning and data analysis technology, bank staff can classify the customer's credit data into different risk levels to identify the potential risk factors of customer credit accurately. This will effectively reduce the profit erosion caused by the non-performing loan ratio.

The existing papers have reviewed the related research and application of AI technology, for example, Xiaojie Zhang discovered how to use Deepseek to promote the reform of banking intelligence [6]. C Bhattacharya et al. discussed How can artificial intelligence be used to improve the customer experience of banks [7]. Armutcu probed the influence of bank AI on customer's willingness on consuming [8]. However, since the publication of such papers, the big data and artificial intelligence technology have been updated and iterated while the economy of the global is damping, it is more and more difficult for banks to supervise the market risk, and the efficiency of banks is affected. AI technology happens to have the ability to integrate financial market and customer information, so that there are more and more banking staff or scientific researchers notice the application of AI in bank risk management. Therefore, it is necessary to summarize and comment the existing research which are related to AI, and further investigate the research value and directions of its combination with bank risk management

This paper is developed according to the following lines. Firstly, the author introduced the development of AI and its application in bank management. After that, the author reviews the application of AI technology in bank management from the perspective of risk management. In the end, this paper summarizes the full text and looks forward to the related research prospects and directions.

2 The Development of AI Technology and its Application in Banking

2.1 The Development of AI

Since the birth of artificial intelligence in the middle of the 20th century, it has experienced a road of technological evolution from the embryonic theory to the full penetration of human society, and it is a key enabler of a new evolutionary phase of human knowledge [9]. Its development trajectory not only reflects human's exploration of the nature of "intelligence", but also profoundly reflects the intersection of computational science, neuroscience and engineering practices. During the 1847, a kind of formal language was described by George Boole for the first time [10]. From that time, more and more scientists put their effort into the field of computer and artificial intelligence research. For instance, in the 1950s, a philosophical question of "Can machines think?" which was posed by Turing laid the ideological foundation for artificial intelligence[11]; At the Dartmouth Conference in 1956, trying to reproduce the inferential capability through rule coding, the scientists McCarthy and Minsky and other pioneers formally established the discipline framework, and they put their effort in symbolic logic and expert system. In conclusion, during the period that mentioned above, the research of AI is based on the “physical symbol system hypothesis”, and the essence of intelligence is the logical operation of symbols, the scientists wanted to simulate the human reasoning process by rules system. In this way, there were many representative results, for example, Herbert Simon and his colleagues who worked in the RAND Corporation developed a system called the Logic Theory Machine [12], and during 1966, Joseph Weinbaum, a famous psychotherapist, who exploited the first chatting robot in MIT [13]. Although such systems could demonstrate reasoning abilities in many specific domains, it was relied on human-written rules, for this reason, these systems were lake of common-sense reasoning and the bottleneck of computing power that led to AI's first winter.

When symbolism that mentioned above was in trouble, Connectionism, inspired by the biological nervous system, came to the fore. In 1982, the introduction of Hopfield networks revived the study of neural networks [14]. And in his theoretical model about fully interconnected recurrent neural network model, the principle of physical energy minimization is introduced into neural network design for the first time. Constructing the energy function, this method not only proved the stability of the network theoretically, but also realized the function of pattern storage and noise fault tolerance through the memory mechanism and solved the fundamental defect that Rosenblatt perceptron cannot deal with nonlinear problems. In 1986, the breakthrough of backpropagation algorithm made multi-layer perceptron training possible. Research on the precursor to deep learning by Jeffrey Hinton et al., together with advances in statistical learning methods such as support vector machines, constitute a new paradigm for machine learning. And there were many milestones during the time from 1980-2021, which was considered as the time for revival and hibernation of neural networks. For instance, IBM Deep Blue's victory over chess champion Garry Kasparov in 1997[15], and the theory about deep belief networks introduced by Hinton's team in 2006 which set the stage for the subsequent explosion. However, because the small scale of data and computing power at that time, connectionism was still in the period of technological accumulation in the first decade of the 21st, and AI were mainly concentrated in limited fields such as industrial control systems and speech recognition. It was not until the double breakthrough of GPU parallel computing and Internet big data that conditions were created for the qualitative change of AI.

In recent years, the field of advanced robotics has been revolutionized because the Artificial Intelligence (AI), Machine learning (ML) and deep learning (DL) have advanced rapidly [16]. Among these three points, the most disruptive technological transition period of AI development is revolution in deep learning, which is a kind of machine learning [17]. During this important and meaningful time, with the help of the data, computing power and algorithms, scientists and many scholars promoted machine intelligence from laboratory theory to large-scale industrial applications, which has completely reshaped the technological landscape of human society. In 2012, it was a symbol of a new era of AI had begun that the Alex Net made a breakthrough in the ImageNet. Meanwhile, combining with the popularity of open-source frameworks, the technology revolution of convolutional neural networks (CNN), recurrent neural networks (RNN), and generative adduction networks (GAN) have made AI to a leapfrog-forward development in areas such as image recognition and natural language processing. Taking the emergence of AlphaGo which over Lee Sedol in competition of Go (2016), GPT-3 (2020), and the proposal of Transformer architecture for example, the using of AI has refreshed the boundaries of human cognition of machine intelligence constantly. The technological breakthroughs of this era are marked by three key characteristics: the replacement of manual feature engineering with end-to-end learning, the exponential growth of big data and computing power driving large-scale model development, and the rapid transition of AI technologies from research labs to real-world industrial applications. The deployment of AI in application scenarios such as medical image diagnosis, autonomous driving, and intelligent recommendation systems has positioned it as a foundational infrastructure of the digital economy. However, challenges such as the black-box nature of deep learning, data bias, and high energy consumption have prompted a re-evaluation of current technological pathways.

2.2 The Contrast Between Different AI Models

From 2022 to 2025, the technology of AI has achieved high-quality development. However, different AI has different talents. Following table 1 shows the difference advantages between three main AI models.

Table 1. comparison between different AI

Study	AI model	Key finding
J Achiam et al [18].	Gpt-4	Ability to deal with image and text input; has the same level as humans in professional examinations
Daya Guo et al [19].	DeepSeekCoder-v1.5	High level of coding performance, but also demonstrated enhanced natural language understanding
Anichur Rahman et al [20].	Gemini	Gemini offers concise visual reasoning

2.3 The Application in Banking

AI like GPT is penetrating many fields at an alarming rate [18], and the banking industry is no exception, during the period of rapid development of science and technology. Financial technology like AI has brought many advantages to commercial banks in its business development and management [19]. For example, with the help of big data and AI, the banker can more accurate understanding of customer needs to provide customers with personalized financial products and services, and through the analysis of customers' behavior of consumption or financial preferences , we can launch customized financial products and loan programs to improve customer satisfaction and loyalty[19].In addition to the application of artificial intelligence in customer needs mentioned above, risk management as the bottom line of banking business survival should also be paid attention to. Nowadays, the fundamental changes to bank risk management have taken place due to the deep involvement of artificial intelligence technology, in the one hand, the AI technology not only solves the pain points of low efficiency, strong lag and narrow coverage dimension, In the other hand, it builds a core barrier for against the systematic risk, so that, AI had become an important pillar for the stable operation of the modern financial system.

There are many types of risks in commercial banks, and the sudden risks are difficult to predict [20]. In bank management without AI, the risk management mainly relies on manual experience, static rules and historical data analysis. First, in the process of credit approval, the staff in bank should collect the financial statements and collateral values provided by customers to judge if they can get the loans. The limitations of this model are obvious, the efficiency of manual is very low, which leads to limited expansion, while the delayed updating of rule base is difficult to cope with the new risks, and the data analysis of single dimension cannot capture nonlinear correlation in complex market environments. To deal with such advantages, in general bank risk management, the bank usually take method by using linear model or some other complex models based on math, for example, with the supervision of the Basel Committee, the central banks of the major monetary centers adopt the system of VaR to value the market risk of banks they supervised, and banks must report VaRs to banking regulators with their internal models and these models must meet the Basel backrest standards[21]. However, by integrating multi-source heterogeneous data, building dynamic learning models, and realizing millisecond level decision responses artificial intelligence technology can completely breaks these bottlenecks. And based on deep learning, the staff in banks can extract the risk signals by using AI technology to filtrate an ocean of information like customer behavior logs, social media feeds and supply chain information.

Of course, there are many other intricate risks in bank management. When the financial market encountered a black swan event, which is regarded as serious market crashes or financial meltdowns by Nassim Taleb in his book named The Black Swan: The Impact of the Highly Improbable[22], it is difficult for the bankers to deal with such situation by relying on statistical tools such as historical volatility and variance-covariance matrix that they used in normal risk management. Meanwhile, with the rapid acceleration of intelligence, the scientists or other financial staff can capture the capture nonlinear relationship from different asset classes by using AI technology's deep learning ability of the analysis to high-frequency trading data, geopolitical events and macroeconomic. In this way, AI technology can simulate thousands of extreme financial market scenarios, automatically generate hedging strategies and verify their effectiveness, and through this method, people can find how to make forward-looking decisions, significantly improve the scientific nature of capital adequacy management.

3 Core Application Scenarios of AI in Bank Risk Management

3.1 Credit Risk Management

From the perspective of finance theory, one of the four balance sheet risks management is credit risk management [23]. The application of AI technology in bank credit risk management has formed a life cycle management which covers pre-loan, mid-loan and post-loan. In general, credit risk refers to the risk that due to various reasons, such as the borrower or debtor cannot repay the debt or they cannot fulfill the contractual obligations on time, which have resulted lose in creditors or bank [24]. The core value of

AI technology is reconstructing the traditional paradigm of credit risk management by data penetration, algorithm iteration or deep learning. Compared with the relying on traditional patterns of artificial rules and static models, AI technology not only realizes the jump in risk identification accuracy and efficiency, but also promotes the transformation of credit risk management from passive defense to active prediction, from single point control to ecological governance, and becomes the core infrastructure of modern banking industry to resist credit risks.

With the help of AI technology, the bank credit risk management system is reshaped through the three major capabilities of multidimensional data fusion, dynamic model optimization and associated risk identification. When before using AI, traditional credit risk management relies on structured data such as financial statements and collateral value, and this has many disadvantages such as a single risk assessment dimension and strong lag, which make it complex to deal with the risk transmission effect in a complex economic environment. However, the system of AI technology can collect some unstructured data such as enterprise supply chain transaction flow, IOT device operating status, social media public opinion, etc. For example, to solve the problem that there are many people who need loans in China, but the quality of them is uneven, this makes a big challenge to the bank business, AI can explore the promotion of science and technology to the credit and loan business, especially the promotion of credit products with high manual involvement and customer service [25].

When it comes to the risk of post-loan, to achieve accurate and forward-looking risk management and control, AI-enabled risk monitoring system can reconstruct the risk early warning mechanism and disposal process. Traditional post-loan management relies on periodic report review and manual sampling inspection, which has problems such as large monitoring blind areas and slow response speed. However, the loan repayment rate will be increased, if the staff can take ex-post monitoring to improve the effectiveness of loan usage [26]. From this point, in the perspective of the author, model of customer behavior, the AI system tracks 300+ risk indicators such as fund flows and account activities in real time, and intelligently identifies potential default signals.

3.2 Market Risk Management

The market risk management is one of the core sections, which is undergoing a paradigm change brought by artificial intelligence technology. And the market risk management of bank means the possibility that a bank may suffer losses because of changes in market variables [27]. With the deep application of AI, people can improve the effectiveness of banks in responding to market fluctuations by using AI to do data mining, pattern recognition and intelligent decision making.

The first step to make risk management is Identifying risks [28]. Traditional risk identification mainly relies on historical data regression analysis and expert experience judgment, which has some defects such as strong lag and single dimension. With the help of AI, bankers can construct a frame for multidimensional data fusion analysis to achieve real-time dynamic capture of risk factors. For example, with the help of natural language processing (NLP), we can parse unstructured data such as Federal Reserve meeting minutes and geopolitical events in real time. Combining with the network named LSTM we can build a model to anticipate exchange rate fluctuations in advance, and the Brexit event has proved the validity of this theory [29].

4 Conclusion

AI technology has become one of the core technologies which applies in the financial industry gradually and it provides strong technical support for banks' credit and market risk management innovation. With the help of information integration, dynamic implementation of supervision and other capabilities that AI has, the banker can manage the life-cycle management of credit, risk control and other businesses to reduce the risk of the bank and protect the bank's interest. However, the author finds there are still many challenges in the application of AI. For instance, it is difficult for some complex AI model to understand and explain the process of decision, so that, it is hard to justify lending to customers and regulators. However, form the perspective of the author, the author believes with the development of AI, the Scientists can solve such problems.

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