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RISK ASSESSMENT AND CONTROL OF BANKS' GREEN FINTECH BUSINESS IN CHINA IN THE DIGITAL ECONOMY: A QFD AND AHP-ENTROPY APPROACH-BASED PERSPECTIVE

JiaGuangyu[a], DuanHuijuan[a]
a. Business School，Shandong jianzhu University，Jinan City，Shandong Province，250101，China

ABSTRACT
With the rapid development of the digital economy, the widespread use of green finance and fintech business has led to remarkable results in the digital transformation of banks. The accompanying financial risks of banks cannot be ignored and have now become a relatively hot academic topic for international research. In this study, we innovatively draw on the quality function deployment theory in marketing, and combine the hierarchical analysis and entropy value method in fuzzy mathematics for quantitative calculation. Different from the classical hierarchical analysis, we fully consider the credibility and identity information weight of experts in the case part, which makes up for the shortcomings of the traditional hierarchical analysis because of too much subjectivity. In this process, the calculation results are finally outputted through a combination of quantitative and qualitative approaches to deeply explore the risk assessment of green fintech business of banks in China in the era of digital economy. In our research, we have applied theories and methods to the risk assessment of banks' green fintech business from a holistic level, and more importantly, we have constructed a risk indicator system for banks' green fintech business. Unlike the traditional risk indicator system, we fully consider the green factor and give the ranking results of the indicators to demonstrate the applicability of the method. The study has achieved innovation and practical application at the theoretical level, enriched the theoretical knowledge of financial risk assessment, expanded the research literature in this field, and provided reference for the Chinese government and financial regulators to formulate control measures for banks' financial risk business, as well as provided relevant ideas and methodological support for international academic cases of similar financial risk management.

Keywords: Financial Risk Assessment, Green Fintech Business, Quality Function Deployment, AHP-Entropy Method, Digital Economy

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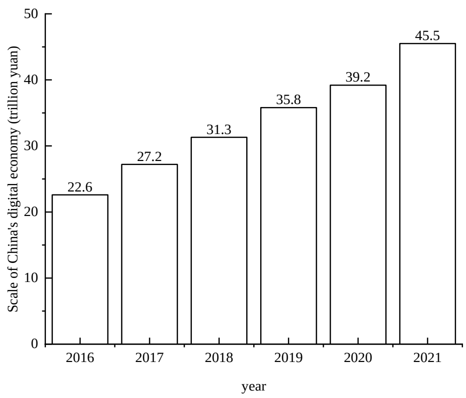
1 INTRODUCTION

The digital economy is a general term for economic activities that take digital information and knowledge as factors of production, use information technology network as a carrier, and use ICT to promote efficiency improvement and macroeconomic structure optimization. With the rapid development of the Internet, big data, cloud computing, artificial intelligence, 5G communication and other emerging technologies, a new economic form after industrial economy and agricultural economy is gradually derived, and the above-mentioned emerging technologies The booming development of the above-mentioned emerging technologies has led to the development of bank fintech business in the era of digital economy, coupled with the relatively popular concept of environment, green and sustainability in recent years, the study of green fintech business has gradually started to take shape.

In June 2017, the People's Bank of China proposed the "Thirteenth Five-Year Plan" for the development of information technology in China's financial industry, which will face new challenges in financial supervision and risk prevention due to the limitations of technology maturity and the gradual increase in the coverage and complexity of fintech business. In January 2022, the China Banking and Insurance Regulatory Commission issued the "Guidance on the Digital Transformation of the Banking and Insurance Industry", which proposed to establish a multi-layered, broad-coverage and differentiated digital financial system by 2025. In January 2022, the People's Bank of China issued the Financial Technology Development Plan (2022-2025), which points out the maintenance of a fintech risk repository, vulnerability repository and case repository to enhance the identification and resolution of digital channel risks, intelligent algorithm risks and big data risks. In terms of green financial policies, the "Recommendations of the Central Committee of the Communist Party of China on Formulating the Fourteenth Five-Year Plan for National Economic and Social Development and the 2035 Vision", adopted at the Fifth Plenary Session of the 19th Central Committee of the Communist Party of China in October 2020, continues green and low-carbon development, formulates legal and policy safeguards for green development, further develops green finance, and improves the prediction of economic security risks In December 2020, China's Ministry of Finance issued the "Performance Evaluation Measures of Commercial Banks" mentioning the new condition of green credit ratio in the assessment of serving national development goals and the real economy. in June 2022, the China Banking and Insurance Regulatory Commission issued the "Green Finance Guidelines for the Banking and Insurance Industry", which elevated the development of green finance in the banking and insurance industry to a strategic level, while proposing that the banking and insurance industry should incorporate environmental, social and governance requirements into the management process and comprehensive risk management system, and for the first time, governance risk was included in the risk category. It can be seen that the changes in the internal and external environment of the banking industry brought by digitalization may bring new risks or magnify the original risks, so the study of risk assessment of banks' green fintech business in the era of digital economy has become a very hot academic topic in the international arena. Moreover, the policies launched in China one after another invariably pay attention to the transformation of the financial industry in the digital economy environment and the prevention of economic risks that may be presented by emerging technologies. We support the development of green finance and continuously improve the financial risk assessment system.

According to the data from the China Academy of Information and Communication Technology, the scale of China's digital economy has continued to expand during 2016-2021 and has shown a doubling of growth. We have compiled the scale of the digital economy for 2016-2021 as shown in Figure 1 below. We also compiled China's seven major industry Internet indices as shown in Figure 2, based on China Ariadne Consulting's China Industry Internet Index Report 2019-2020, and what can be seen is that the same industry occupies an important position in the process of digital transformation in the financial sector.



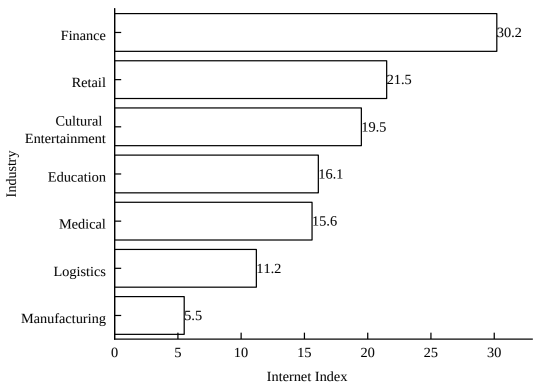
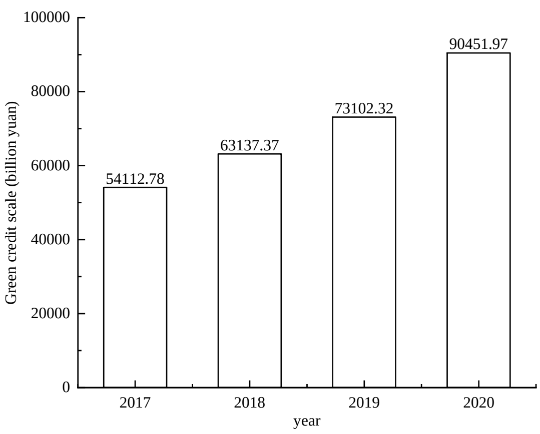


Fig.1 Size of China's digital economy, 2016-2021

Fig.22019-2020 China's seven major industries industrial Internet index

Banks, as representatives of China's financial institutions, green credit has become the backbone of China's financial system. The green credit index has skyrocketed. According to the data of "Green Finance Development Report under Double Carbon Target" in China Zero One Intelligence, the scale of green credit in China has been expanding from 2017 to 2020. Among the 72 banking institutions represented by ICBC, the cumulative balance of green credit increased from 541.278 billion yuan in 2017 to 904.5197 billion yuan in 2020, an increase of 67.15%, with an average annual growth rate of 18.68, of which the cumulative green credit balance in 2020 grew at a rate of 23.73%, and we have green credit scale data from 2017-2020 collated as shown in Figure 3 below. What can also be seen is that after the first launch of green bonds in January 2016, the scale has continued to expand, second only to green credit, and is the second largest carrier of green finance in China. with an issue volume of 550.8 billion yuan in 2020 and a cumulative issue volume of 115.89 billion yuan, we put together the 2018-2020 green bond scale expansion data as a whole as shown in Figure 4 below.



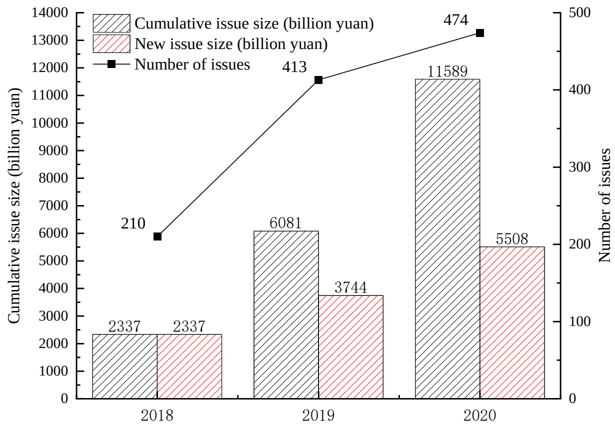


Fig.3 Green credit scale from 2017 to 2020 (billion yuan)

Fig.4 Green Bond Scale 2018-2020

Based on the above background description, our main contributions in this study are threefold. (1) An indicator structure for risk assessment of fintech business was constructed by drawing on the theory of quality function deployment in marketing. The AHP-entropy method is incorporated in this structure to calculate the weights of each indicator, and the applicability of the method in the risk assessment of green fintech business of banks in China is demonstrated through case studies. (2) Applying the theory and method to the case of green fintech business risk assessment of Chinese banks, an innovative index system for the risk assessment of Chinese banks' fintech business considering the green perspective is constructed.

The importance of each indicator is quantitatively calculated, and the ranking results of each indicator are given and the scientific validity and rationality of the method are further verified. (3) The combination of quantitative and qualitative approaches achieves the combination of research theory and practical application, and contributes to the development of the field of bank financial risk by studying the issue of bank financial risk in an interdisciplinary perspective. At the practical level, based on the importance of indicators for the control of banks' fintech business, it is also possible to make relevant countermeasures and recommendations, and the process of applying theory to practice is a more critical place to emphasize and illustrate.

The rest of this paper is organized as follows: part 2 is a literature review, we will mainly sort out the literature related to digital economy, digital economy and banking finance, green finance and fuzzy mathematical theory applied to financial risk assessment problems; part 3 is the basic theory of research, we will give the quality function deployment theory and AHP-entropy value method; part 4 we propose an improved QFD-based green financial technology business risk assessment method based on QFD; Part 5 is a case study to demonstrate the scientific rationality of the theories and methods proposed in this paper; Part 6 is to give countermeasures for risk control of green fintech business of Chinese banks in the era of digital economy with respect to quantitative calculation results; Part 7 is the conclusion of this paper.

2 LITERATURE REVIEW

We focus on the risk assessment of banks' green fintech business in the era of digital economy in this study, proposing a qualitative analysis using mass function allocation theory and a quantitative study through hierarchical analysis and entropy value method, with the ultimate goal of proposing relevant countermeasures for the prevention and control of banks' fintech business risks. Therefore, this research review will be conducted at three levels, namely, the digital economy, fintech and green financial management, and the application of fuzzy mathematical theory in bank investment decision making, performance evaluation and risk management, as described below. We combed the thought diagram of the literature review, as shown in Figure 5 below.

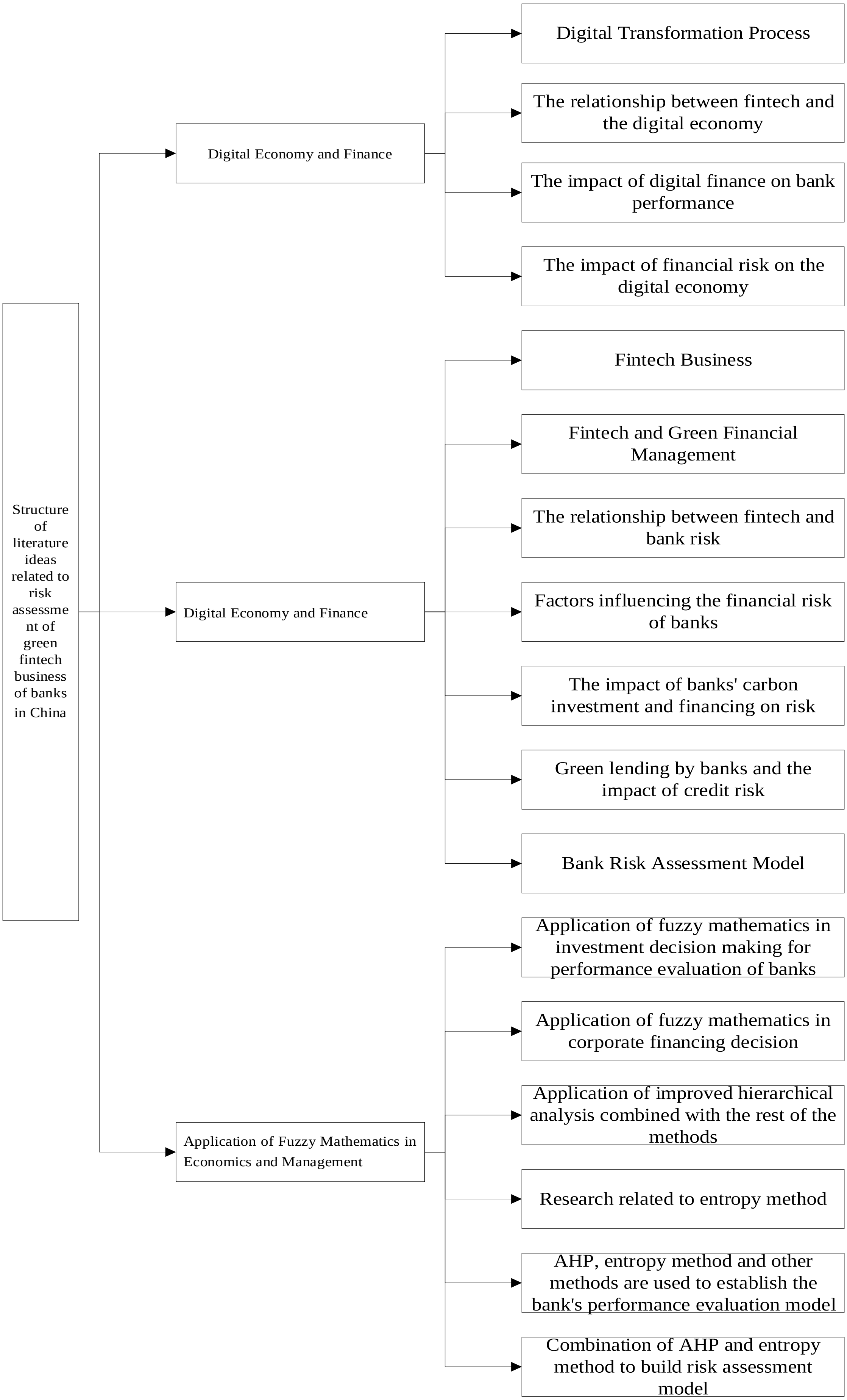


Fig.5 A framework of ideas for the literature review of this study

In the digital economy, the current international focus on issues regarding the digital economy and banking and finance is rich in research results, mainly from the perspective of digital transformation of banks, fintech and other in-depth studies. Nambisan et al [1] incorporate the economic needs of digital transformation into multiple and cross-level analyses, expanding the concept from multiple domains to clearly understand the relationship between digital technology in organizational and social transformation relationship. Liu et al [2] explore the development process of digital transformation through a digital banking project based on the concept of resource matching. Their most significant contribution is a resource matching framework that integrates both theories. This framework provides theoretical enhancements in the resource matching literature. Naimi-Sadigh et al [3] explore how banks implement digital transformation and how digital transformation is carried out through these steps. They established a clear process, using a specialized bank in Iran as an example, so as to develop and utilize the bank's innovation through new technologies and digital methods. All the above three studies are related to digital transformation and although their findings are somewhat different from our study, whether banks are transforming in a particular digital economy reflects whether they can follow the times with the times and can reflect their risk-taking capacity from the side. Chen et al [4] answered what is the nature of the relationship between fintech and digital economy by their study analyzed the impact of fintech on the digital economy and the underlying mechanisms, they concluded that local financial regulatory resources have a positive moderating effect on the impact of fintech for the development of the digital economy. Coetzee [5] identified the strategic impact of fintech in South African retail banks, he argued that future banks will not rely as strongly on physical branches as in the past, while new competitors enter the competition and provide competitive and purely digital solutions. What can be seen is that fintech and digital economy complement each other, fintech is a product of the digital economy era, and the digital economy drives the use of fintech in banking. can help us better understand the concepts related to digital economy and fintech. the study by Ozili [6] aims to achieve greater financial inclusion in developing countries and emerging economies through digital finance. cao et al [7] studied the impact of digital finance in energy and environmental performance in China. they concluded that digital finance stimulates resource and environmental performance more when both credit and capital markets are immature. and suggest that China should accelerate its digital transformation in the financial market. niemand et al [8] develop some insights explaining how banks can use tactics and strategies related to entrepreneurial orientation to achieve superior performance in the digital era. We found that digital finance has a positive impact on bank performance and can stimulate environmental performance, affirming the plausibility of the next research on green fintech business of banks in the context of the digital economy, providing inspiration and theoretical support for our research on green finance in the digital economy. Yuan et al [9] studied the impact of digitalization in economic innovation, R&D expenditures in real business finance, revenue, and financial risk. They provided useful recommendations for policy makers in G7 countries in designing digital economy, banking finance and technology innovation. The study points out that financial risk has a negative impact on STI in the digital economy and provides guidance on the selection of our financial risk indicators. The research in this section focuses on the digital transformation of banks, the interrelationship between fintech and the digital economy, the impact of digital finance on bank performance, and the impact of financial risk on the digital economy. The current research results can all provide reference for our present study to discuss the green fintech risk assessment of banks in the era of digital economy, however, it is noteworthy that few studies have considered the digital economy and green finance as a whole to study the risk assessment of banks, lacking the combination of low-carbon environment, and our current study focuses on this issue to make arguments that can reflect the real problems and complement the existing research, which we believe can provide theoretical and practical application contribution value to academic research related to risk assessment of banks' green fintech business in the digital economy era.

There is a wealth of international research on bank financial risk. scholars have extensively discussed and argued different aspects of fintech business, bank green finance and risk, and bank risk assessment models, providing theoretical and methodological experiences for the next studies in this paper.

langley and Leyshon [10] propose a critical understanding of fintech as a political economy platform that dividing fintech into three distinct and related processes: reintermediation, integration and capitalization. gomber et al [11] propose a new approach to fintech innovation that is able to assess the degree of change and transformation in four areas of financial services. lee and Shin [12] discuss the ecosystem, business models and types of investments in the fintech sector. Finally, the technical and managerial challenges of fintech startups and traditional financial institutions are presented. Thakor [13] provides a definition of fintech and suggests future research questions and directions by reviewing the literature on fintech and its relevance to the banking industry. It is worth noting that these studies are related to fintech and keep pace with the times. Banks are now gradually increasing their fintech business, and studying the increasingly flourishing fintech can help us learn more about the changing business of banks with the times, yet these business changes can precisely reflect risk-taking capabilities. Yang et al [14] study empirically examined the impact of green finance and fintech on high-quality economic development, and they concluded that while fintech has a significant impact on the relationship between green finance and economic efficiency between green finance and economic efficiency has limitations, but enhances the positive impact of green finance in ecological environment and economic structure. Chen and Zhao [15] study elaborated that intelligent service system provides new perspectives and methods for green financial risk management and applies intelligent service in green financial risk management to promote sustainable development of green finance and enrich the theoretical system of intelligent science. Tao et al [16] verified whether the development of FinTech contributes to the smooth transition of economies to low carbon and GHG emission levels, and they confirmed that the development of FinTech in fact contributes to the reduction of GHG emissions after the inclusion of appropriate control variables. To our surprise, the existing research explores green finance and fintech together, and the mutual reinforcement between the two in the conclusion provides inspiration for our next study to discuss the relationship between these two concepts in conjunction with bank risk-taking.Hu et al [17] elaborate on the interrelationship between fintech and traditional finance, and they argue that the synergy between fintech and traditional finance and the development of fintech does effectively reduce the risk-taking of commercial banks. Cheng and Qu [18] explain the impact of bank fintech on credit risk. They concluded that bank fintech in state-owned banks developed faster than other banks and that bank fintech significantly reduced the credit risk of Chinese commercial banks. Both studies show that fintech can effectively reduce commercial banks' risk-taking, validate the relationship between fintech and bank risk in our study, and illustrate the process of financial indicator construction. Although the focus of our current study is on green finance, indicators related to fintech can be added later to further deepen the study. Bingler and Senni [19] focus on climate-related financial transition risks and propose a set of analytical criteria based on climate science, economics, finance, and risk management, so as to assess whether climate transition risk analysis tools provide high-quality, comparable, and decision-relevant results. Even though the climate-related financial transition risk in this study deviates somewhat from our research, the multidisciplinary intersection opens up our research ideas while the climate-related concept reflects whether the firm has undertaken green development. Qiao et al [20] illustrate how Internet finance affects the relationship between commercial banks' risk appetite and monetary policy and discuss whether this effect varies across banks, and they argue that Internet finance changes the sensitivity of banks' risk behavior to monetary policy. Abdul-Rahman et al [21] dissect whether financial services affect banks' liquidity risk, and they argue that the increase in the amount of real estate financing and short-term financial stability of Islamic banks may increase their short- and long-term liquidity risk. To our appreciation, scholars have extensively studied the factors influencing the financial risk of banks, allowing us to understand from a multidimensional perspective that Internet finance, the type of bank, and financial services are all factors related to the financial risk of banks, which are better able to control the corresponding variables in our study and enhance the rigor of the article. Anna et al [22] studied that in addition to providing capital and reducing risk, state investment banks play a broader role in facilitating the shift from private to low-carbon investments. Umar et al [23] assess the impact of carbon neutral loans on credit risk in the euro area. They concluded that the risk of carbon neutral loans is negatively related to the risk of default, and the impact of green financing on credit risk is the same regardless of the size of the bank. Zhang and Li [24] conducted a risk analysis of six Chinese banks involved in carbon financing, and they identified exchange rates and oil prices as key factors to be considered in carbon financing, and their findings provide Their findings provide some insights into the linkage between carbon trading and carbon markets in China. The impact of banks' carbon investment and financing and carbon neutral loans on risk is actually a dissection of the change of banks' risk-taking ability after adopting green finance-related measures, and at this stage, banks are gradually participating in carbon neutral carbon investment and financing to cope with the changing external economic environment, which is combined with green finance-related contents, proving the existence of a certain relationship between green finance and risk and affirming the scientific nature of our study. al- Qudah et al [25] aimed at the effect of green credit policy on non-performing loans in UAE banks and investigated the financial risks associated with green loans and they concluded that the percentage of green loans has a negative impact on the non-performing loan rate. Zhou et al [26] empirically tested the relationship between banks' green loans and their credit risks and their findings can help policy makers to develop green finance policies based on banks' characteristics. Del Gaudio et al [27] investigated the effect of banks' propensity to lend green on profitability and risk, and they concluded that higher propensity to lend green was associated with lower profitability, lower default risk, and lower credit risk than banks with less green investment patterns. We are very grateful to these studies, all of them point out the impact of green lending by banks with credit risk, which is part of our study, and the common measures of credit risk by scholars give us a great reference value. Zhou et al [28] constructed an evaluation of regional economic green growth based on an in-depth analysis of the mechanism of the impact of green finance on green growth from the perspective of financial technology development. growth. Bessler and Kurmann [29] analyzed the capital market assessment of bank risk factors in Europe and the U.S. They concluded that banks' risk exposure is multidimensional and time-varying, but well reflected in bank stock returns. Bai and Zha [30] constructed a genetic algorithm and neural network from the standpoint of commercial banks' credit risk assessment model for commercial banks. Essentially, both their study and ours assess green growth or risk after building a composite indicator. The overall indicator construction process and risk assessment logic can be learned from a macro perspective, such as first categorizing and elaborating the core concepts, then selecting the relevant indicators, and finally constructing the model for assessment. This part belongs to the theoretical foundation of the article, which provides an in-depth study on the green fintech risk of banks from the perspectives of conceptual definition of fintech business and green finance, influencing factors of banks' financial risk, indicator construction and evaluation, which provides experience for the overall framework of our article and the landing point of the study. However, what can be seen is that few studies have been conducted to assess the risk of banks' fintech business from the background of digital economy. Our study will be launched in the future with the background of digital economy and focus on the risk assessment of green fintech business, which we believe can provide theoretical guidance and practical significance for the assessment of banks' green financial risk.

For fuzzy mathematical theory, it has been commonly applied in financial management decision making, performance evaluation, risk assessment, etc. What can be seen is that the existing international research widely incorporates the theories of hierarchical analysis, entropy value method, fuzzy comprehensive evaluation method, TOPSIS method, cumulative prospect theory, intuitionistic fuzzy sets, interval fuzzy sets, and hook fuzzy sets in business decision making, bank investment and financing, performance evaluation, risk assessment, etc. Kou et al [31] proposed an evaluation portfolio model considering interval fuzzy decision making for determining the most important factors for fintech-based investment selection to improve the financial performance of European banks, and they concluded that fintech-based investment in remittance systems can help reduce costs. Seyfi-Shishavan et al [32] discussed a new and extended intuitionistic fuzzy best-worst approach to determine the weights of key factors and use a fuzzy inference system to obtain performance indicators in the banking industry. They argue that credit risk, income loss and liquidity are the most critical factors for the outbreak of neocoronavirus pneumonia in the banking industry. Puri and Yadav [33] extend fuzzy data envelopment analysis to intuitionistic fuzzy envelopment analysis, especially triangular intuitionistic fuzzy numbers, and they present application of the proposed method in the banking industry. Ren et al [34] extended the interactive multicriteria decision method based on prospect theory to solve multicriteria decision problems with hooked fuzzy set information. They validated the applicability of the method by conducting a case study on the selection of the president of the Asian Infrastructure Investment Bank. The above studies are applications of interval fuzzy, intuitionistic fuzzy, and hook-fuzzy sets in fuzzy mathematics to the banking industry. It shows that fuzzy mathematics has been commonly used in studying performance indicators and investment decisions of banks, confirming the rationality of applying fuzzy mathematics to the evaluation of the banking industry in our study. Chun [35] proposed the application of a combination of triangular fuzzy numbers and hierarchical analysis (AHP) to the decision-making process of the optimal solution for external equity financing of startups in the fintech industry, where they considered the cost of capital is the most important criterion for evaluating the optimal solution of external equity financing methods. Li et al [36] proposed a financing decision method based on nonlinear differential equations, and the results of the study argued that the financing decision method based on nonlinear differential equations can obtain more appropriate financing decisions through calculation. Li et al [37] refined a multilevel fuzzy integrated evaluation method for financing credit of MSMEs through a cloud model. They verified that the model can reduce the randomness and uncertainty in the process of determining indicator weights and member ratings, thus improving the robustness of the evaluation. It is noteworthy that scholars have demonstrated the application of fuzzy mathematics in corporate financing decision making, and fuzzy mathematics is quite mature internationally in the study of economic management and finance, further proving the feasibility of our chosen fuzzy mathematical research method. Li et al [38] studied the combination of hierarchical analysis and fuzzy comprehensive evaluation methods, and proposed an improved hierarchical analysis-fuzzy comprehensive evaluation algorithm, and they The proposed evaluation model is widely used in CSR performance evaluation. Wu et al [39] used hierarchical analysis as an indicator weight measure for group decision making and the concept of gray relational degree was introduced into the superior-inferior solution distance method TOPSIS, and they verified the effectiveness of these two improved methods in an empirical study of credit risk analysis of Chinese urban commercial banks. Interestingly, the application of the improved hierarchical analysis method incorporating the fuzzy comprehensive evaluation method or TOPSIS method provides us with the basic knowledge and specific application process of hierarchical analysis method, and more importantly, the idea of improvement and optimization in combination with other methods. Unvan and Ergenc [40] pointed out the fuzzy community discovery algorithm and entropy method for bank financial performance assessment, they also determined the weight of each criterion and the importance of the alternatives. Liang [41] et al. defined hooked fuzzy entropy and cross entropy metric weights and designed two strategies for the combination between interactive multi-criteria decision making and multi-criteria compromise solution ranking methods, and finally They gave a simulation example of ranking online banking sites in the Ghanaian banking industry to demonstrate the effectiveness of the method. Chen [42] explained the effect of the entropy method on the ranking preference technique similar to the ideal solution (TOPSIS) based on extensive data and theoretical analysis. Similarly, these related studies on the entropy method show us the calculation process and methodology of the objective assignment of the entropy method, and the rationality of its steps can be used for subsequent methodological studies. Reig-Mullor and Brotons-Martinez [43] proposed to combine intuitionistic fuzzy numbers with hierarchical analysis and TOPSIS, and they used the method for the Spanish commercial banks for global performance assessment. Aras et al [44] used content analysis, entropy weighting and TOPSIS methods to develop a corporate sustainability performance assessment model for Turkish banks.They argued that improving performance in all dimensions can provide a substantial contribution to a bank's overall score and ranking. Tuysuz and Yildiz [45] constructed a hybrid multi-criteria banking performance assessment model, i.e., a simulated integrated hierarchical analysis approach based on fuzzy linguistic term sets, and a gray relational analysis approach, and validated the practical application of the performance assessment model in the Turkish agricultural banking sector. It should be noted that the scholars first provide a theoretical overview of research methods such as AHP and entropy method, then improve the existing methods and design a model that complements the subjective and objective empowerment methods, and finally validate the effectiveness of the model in bank performance assessment. Although they are assessing bank performance, this overall logic is still applicable to bank risk assessment. Huang [46] used entropy method-fuzzy hierarchical analysis to evaluate green financial capital operation risk, and the results found that entropy theory and fuzzy integrated evaluation method are still applicable to the assessment of green investment risk. Li et al [47] used entropy empowerment and hierarchical analysis to propose for customized product development An evaluation method for high customer satisfaction was proposed by Li et al. They applied the proposed method to a case study in the custom portrait product industry to demonstrate the functionality of the proposed method. It is very wonderful that both studies use hierarchical analysis and entropy method, which are consistent with our research methods, especially the first study is on the assessment of green investment risk, which provides a model and reliable support to our research. We highly recognize these studies, and the research in this section argues the scientific validity of fuzzy mathematics in economic and financial research, and provides us with methodological guidelines for the establishment of the next risk assessment model of green fintech business of banks in China in the context of digital economy. However, few scholars have improved the reliability of the subjective empowerment method in the research on the assessment of bank financial risks by combining the hierarchical analysis method with the entropy method in the credibility of the hierarchical analysis experts, in addition to which few scholars have combined the quantitative research method in fuzzy mathematics with the qualitative research method of the quality function configuration theory. Therefore, we extend this method and believe that we can contribute methods to the assessment of green financial risk business of banks.

The existing international research literature focuses on innovation in the selection of research object classification, design of theoretical indicators, and improvement of fuzzy mathematical methods, mainly in the study of financial investment risk, digital financial risk, and green credit risk, for example, these studies through hierarchical analysis, fuzzy comprehensive evaluation method, TOPSIS method, entropy value method, etc. can provide thought support and reference for our research. However, unlike their studies, our present study focuses on the risk assessment of banks' green fintech business in the era of digital economy. We innovatively draw on the theory of quality function allocation in marketing to construct risk assessment indicators for banks' green fintech business. The quantitative calculation is performed by using hierarchical analysis and entropy value method in fuzzy mathematics, and the calculation results are output by combining qualitative and quantitative approaches. This paper achieves the improvement of theory, the integration of methods, and the combination and innovation of theory and practice.

3 METHODOLOGY

3.1 Quality Function Deployment

The concept of QFD (Quality Function Deployment, QFD) was first proposed by YO JIAKAO, a Japanese researcher in product quality management, and there are many kinds of translations of QFD in international academic research, the more recognized ones are: quality function configuration theory, quality function deployment, quality function deployment and quality house. Although the concept of QFD originated from the field of product quality management, QFD has been widely used in many disciplines and social field applications, such as system risk assessment, financial risk assessment, investment behavior decision, engineering quality management, corporate strategic planning, artistic product design, urban infrastructure design planning, etc. By tracing the initial start and development of QFD, the core idea of QFD is to analyze the customer's needs, study the correlation between the customer's needs and the ways to achieve them and the competition between the needs by focusing on the customer's needs goals, and finally output the results of the importance (weight) assessment of the customer's needs through quality assessment theory and technology. The method is actually a "house" built inside the evaluation system in the field of system management science, and the customized requirements are realized inside this "house". The specific structure of the "house" is shown in Figure 6 below, and the specific expansion is shown in Figure 7. In short, the quality function configuration theory is based on "customer requirements-implementation method-relationship analysis of requirements and methods-quantitative evaluation results". It is based on the core idea of requirement splitting and importance ranking, which is to transform customer requirements into concrete production solutions that can be implemented by targeting the construction of a demand quality house structure model, inputting customer demand factors, and then using quantifiable methods to output quantitative demand calculation results and realize the importance ranking of demand factors.

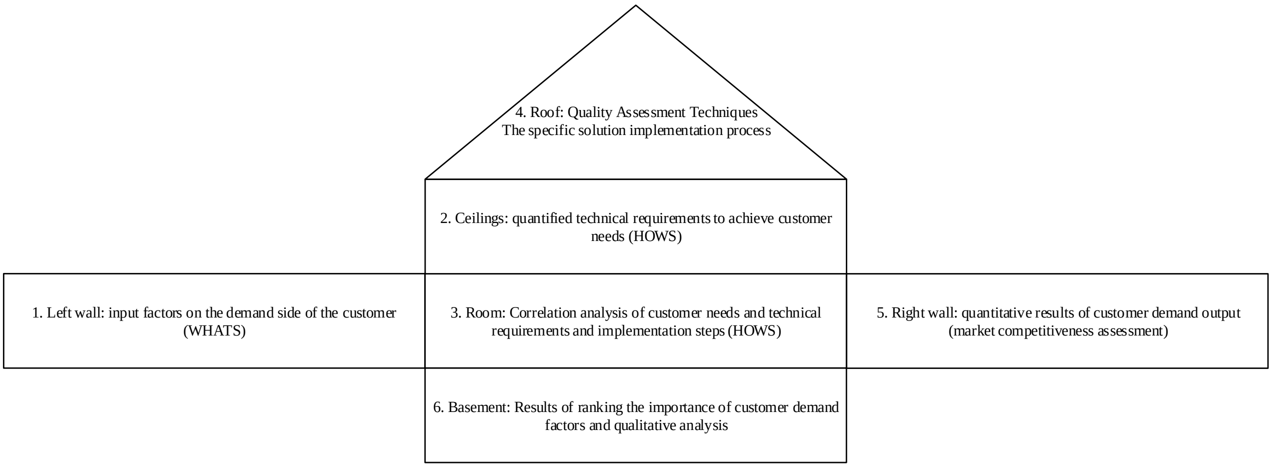


Fig. 6 Schematic diagram of the general form of the mass house structure

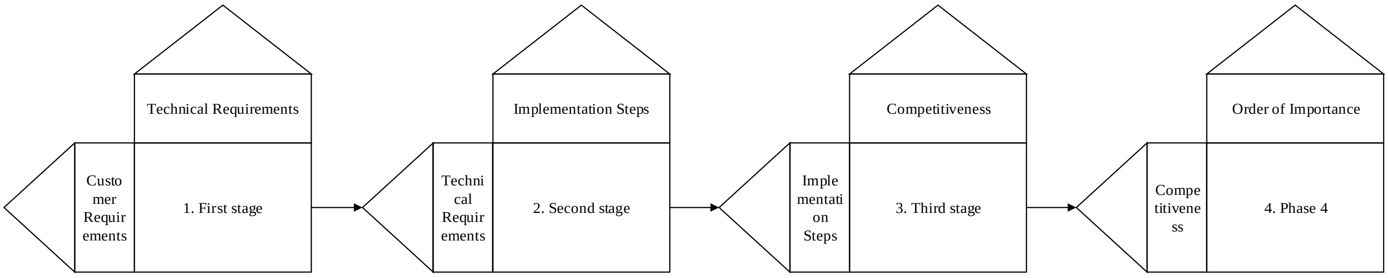


Fig.7 Quality function expansion diagram

1. Left wall: represents the input factors of customer demand side, and indicates the process of customer demand splitting. The specific demand splitting can be obtained by social questionnaire, interview, network information, etc.
2. Ceiling: represents the quantified technical requirements for realizing customer needs, i.e., according to the input factors at the customer's demand end, the corresponding technical methods for quantified needs are provided.
3. Room: represents the correlation analysis and implementation steps between customer needs and technical requirements, i.e. the impact of technical requirements on customer needs, the connection between them and the specific ways of impact.
4. roof: represents the specific solution implementation process of the quality assessment techniques, i.e. the impact of changing one of the assessment techniques on the other and the extent of its impact.
5. Right Wall: represents the output of quantitative results from customer needs, i.e., the feasibility of assessing the technical requirements based on competitiveness from the perspective of customer needs, and thus the output of quantitative results.
6. Basement: represents the results of the importance ranking of customer demand factors and qualitative analysis, i.e., using the results of the above analysis, a comprehensive evaluation of the quality house is performed, so that the combination of assessment techniques can be optimized.

Obviously, QFD is not a quantitative calculation method but an idea used to logically analyze the relationship between customer needs and product characteristics. For the application of QFD, it is now widely used in financial management, economic investment, and business management. Li et al [48] used fuzzy mathematical theory combined with quality-functional configuration theory to carry out research on product development and innovation design, which helps to design efficient financial innovation products can help to solve the financing problems of sustainable resource investors. Golrizgashti et al [49] used quality-functional Erol et al [50] proposed an integrated decision making framework that includes a multi-criteria decision making approach based on quality function configuration theory and a hesitant fuzzy language term set to study the blockchain Chen et al [51] proposed a new integrated multi-criteria decision making approach to improve QFD, and they also validated the feasibility and practicality of the proposed approach using the example of CNC machine tool product design.

Hsu et al [52] proposed an integrated QFD and multi-attribute decision making approach (MADM) in order to study the sustainability identification performance factors of medium-sized companies) assessment model, this integrated approach enables managers to identify key factors of performance and allocate company resources to enable the company to achieve sustainable development. Chowdhury et al [53] used the quality function configuration approach (QFD), which integrates optimal technology design and prioritization of optimal strategies from the application of decision models to support the development and realization of smart and efficient service design decisions. It can be seen that the QFD method is also of cutting-edge research value significance when applied in the field of financial management, and that QFD is cutting-edge and advanced as a system analysis method. Therefore, we will draw on QFD in product quality management as a technical tool for logical analysis research in this study to improve the overall logic and readability of the article.

3.2 AHP

The core idea of QFD is demand splitting and importance ranking, in the specific operation process needs to be applied to quantifiable quality assessment technical means to output demand importance results, similarly, the hierarchical analysis method is also based on the calculation of indicator factors and weights, demand splitting and construction of indicator factors. Unlike other quantitative technical means, we will use hierarchical analysis in this study as a subjective assignment method combined with the objective assignment method entropy method, both of which make up for the deficiencies between each other. We use such an improved method to carry out the study of quantitative calculation of indicators, corresponding to the introduction of the relevance of the analysis of the technical means of quantitative realization of customer needs in the quality house ceiling in QFD theory and the introduction of the steps of implementation of the technical theory in the room. The specific steps of the hierarchical analysis method are shown in Figure 8 below.

3.2 Entropy method

Entropy method is an objective assignment method, which calculates the information entropy of indicators and determines the weight of indicators according to their relative changes on the system as a whole, the greater the degree of relative changes, the greater the weight of indicators, this method is now widely used in all aspects of financial decision science and has high application value, its specific steps are shown in Figure 8 below.

3.3 Portfolio Empowerment Method

We assume that the subjective weights w_1 obtained by the fuzzy comprehensive w_2 evaluation method are α_1 , the objective weights obtained α_2 by the entropy method are $\alpha_1 + \alpha_2 = 0, 0 \leqslant \alpha_1, \alpha_2 \leqslant 1$, and the parameters and are introduced to indicate the importance ratio of subjective weights and objective weights, where , the specific formula of the combined weighting method is $w = \alpha_1 w_1 + \alpha_2 w_2$. For the sake of fairness, we assume in this study $\alpha_1 = \alpha_2 = 0.5$.

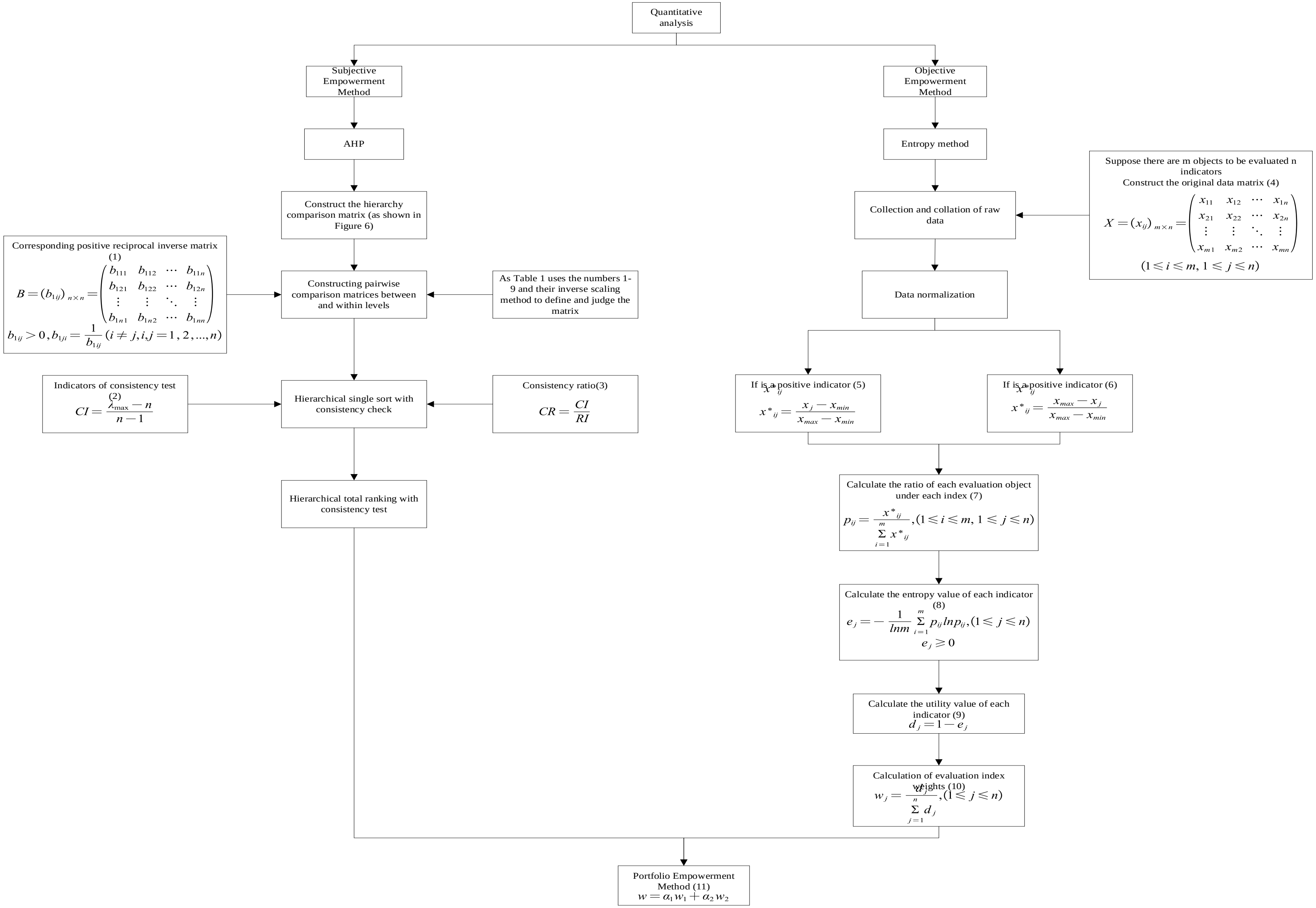


Fig.8 Quantitative analysis structure schematic

Figure 9 below shows a schematic diagram of the construction of the hierarchical comparison (judgment) matrix involved in the hierarchical analysis method of Figure 8

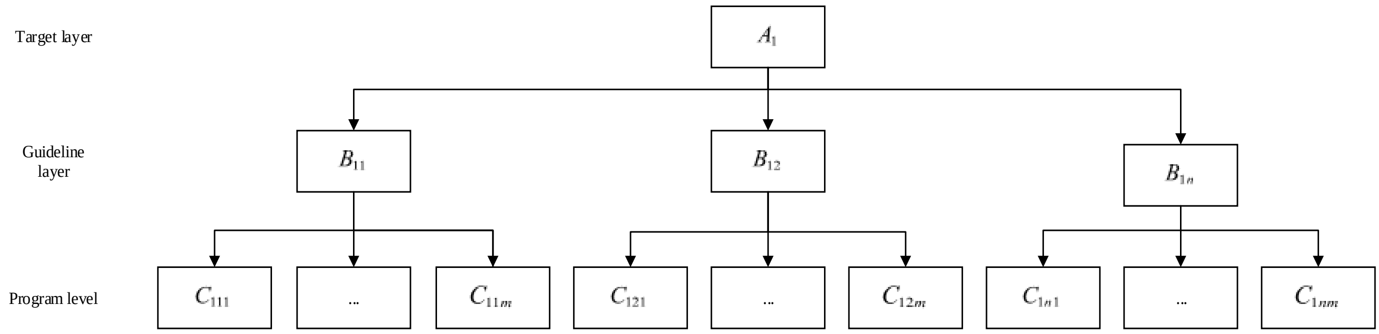


Fig.9 Schematic diagram of the structure of hierarchical analysis

where A represents the set of objectives; B represents the set of criteria, denoted by $B_{1i}=\{B_{11},B_{12},...,B_{1n}\}$ $(1\leqslant i\leqslant n)$, B_{1i} is the first criterion in the set of criteria i ; $C_{1ij}=\{C_{1i1},C_{1i2},...,C_{1im}\}$ $(1\leqslant j\leqslant m)$ represents the set of solutions, C_{1ij} denoted by j , C is the first solution of the first criterion in the set of solutions.

As shown in Table 1, the scaling table of the definition and judgment matrix using the number 1-9 and its inverse scaling method is shown.

Table 1 Scale table

Ruler	Define	Description
1	Equally important	B_{1i} and B_{1j} of equal importance
3	Slightly more important	B_{1i} Slightly B_{1j} more important than
5	Quite important	B_{1i} than B_{1j} quite important
7	Obviously important	B_{1i} than B_{1j} obviously important
9	Absolutely important	B_{1i} more important than B_{1j} absolutely
2,4,6,8	Intermediate value of two adjacent judgments	The relative importance is between the two adjacent levels above

In Equation (2) of Figure 8 above, the maximum eigenvalue of $\lambda_{\max}$ the pairwise comparison matrix, $=0$ whose corresponding eigenvector is the weight vector; , represents perfect consistency; tends to 0, represents satisfactory consistency; the larger it is, the worse the consistency is CI . As Table 2 shows the values of random RI consistency.

Table 2 RI value

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

In equation (3) of Figure 8 above, when the consistency ratio When the inconsistency of the comparison matrix is within the allowed range, there is satisfactory consistency, i.e., it passes the consistency test. In hierarchical total ranking and performing consistency test, the total ranking weights of the program level to the target are calculated, and then the total ranking consistency ratio is tested ( ). If the test passes, the results of the total ranking weights are used for decision making; if the test fails, the model needs to be reconsidered or the pairwise comparison matrix needs to be reconstructed.

4 An improved risk assessment method for green banking fintech business

4.1 QFD-based Quality House Structure Design for Green Banking Fintech Business

Based on the generalized structure of quality function configuration theory introduced in Section 3.1 above, we designed a QFD-based quality house structure for green fintech business risk assessment as shown in Figure 10 below.

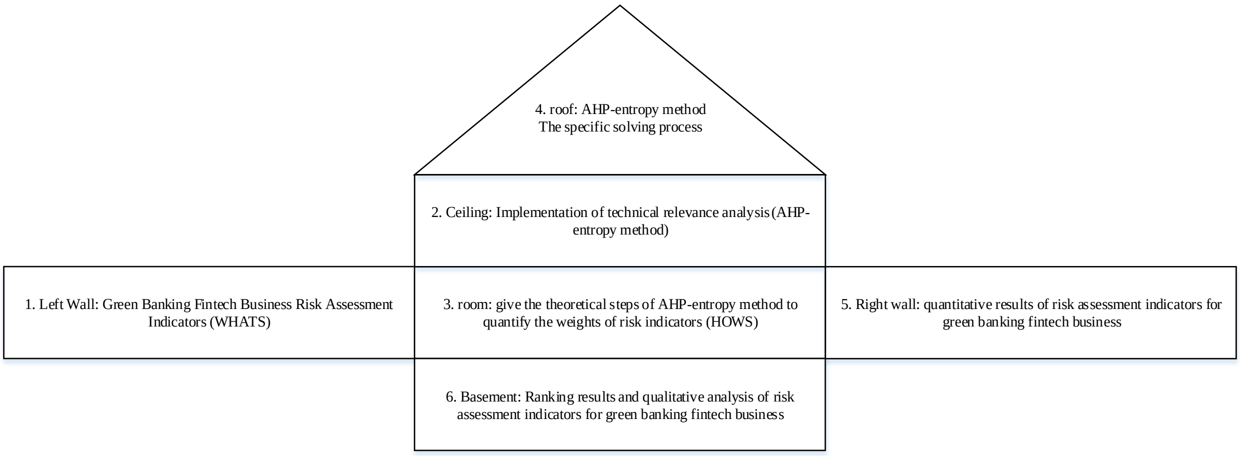


Fig.10 QFD-based Quality House Structure Design for Green Banking Fintech Business

1. left wall: in this study specifically refers to the 15 risk indicators related to green fintech business.
2. ceiling: in this study the AHP-entropy method is used for quantitative calculation.
3. room: in our study specifically refers to the weight calculation results of five experts in the improved AHP method for the 15 indicators, the weight calculation results of the entropy value method, and the combined weight values of the AHP-entropy value method.
4. roof: in this study is the process of risk assessment of green fintech business of banks in China.
5. right wall: in our study specifically refers to the ranking of the importance weights of 15 indicators about green fintech business from the largest to the smallest.
6. basement: in this study is the risk control and countermeasures and suggestions for the key indicators for the green fintech business of banks.

4.2 QFD-based general process for evaluating green banking fintech business

In order to facilitate the smooth conduct of the subsequent study, we sort out the risk assessment process of green fintech business to be carried out in this study by combining the framework structure of QFD.

Step 1: Historical literature collection and literature survey, and preliminary construction of green fintech business risk assessment indicators

Step 2: Conduct actual social surveys and expert consultation interviews to further clarify the structure of the green fintech business risk indicator system

Step 3: Apply AHP-entropy method to quantitatively analyze the indicator weights (importance)

Step 4: Obtain assessment data by questionnaire survey, determine the weight of expert identity information, and apply the subjective assignment AHP method to calculate the risk indicator weights

Step 5: Obtain customer assessment data by indicator attribute characteristics, and perform risk indicator weight calculation using the objective assignment entropy method

Step 6: Combine the results of the AHP-entropy method to determine the importance ranking of risk indicator factors and identify key indicator factors

Step 7: Suggest countermeasures for risk prevention and control of green fintech business based on key indicator factors

5 Case Study: Research Evidence from China

5.1 Defining the risks of green banking fintech business in the digital economy

From the current literature, although there are many studies related to the risk of fintech business, a clear definition of the indicators for the overall evaluation of risk has still not been reached, and the scope of risk coverage has not reached a basic consensus. Therefore, in this study, through reading related materials and combing literature, conducting social research, and expert consultation interviews, we conduct research around the issue of green fintech business risks of banks in China, and consider five major principles that will be defined in terms of credit risk, liquidity risk, market risk, green credit and environmental performance risk, and operational and reputational risk. Focusing on the risk issues of green fintech business of banks in China in the context of digital economy, the index system is constructed around the guidelines, in which the credit risk considered mainly includes non-performing loan ratio, capital adequacy ratio, provision coverage ratio; liquidity risk mainly includes liquidity ratio, liquidity coverage ratio; market risk mainly includes leverage ratio, risk-weighted assets; green credit and its environmental performance risk includes water saving, emission reduction nitrogen oxides, carbon dioxide equivalent emission reduction, chemical oxygen demand reduction, ammonia nitrogen reduction, and green credit loan balance; operational and reputation risks mainly include average return on net assets, and the percentage of graduate students and above. The details are shown in Figure 11 below.

5.2 Risk factor analysis and index system construction of green bank's fintech business

Based on the risk indicators defined in section 5.1, we constructed one primary indicator targeting the risk assessment of green fintech business of Chinese banks, five secondary indicators with the criteria of credit risk, liquidity risk, market risk, green credit and its environmental performance risk and operational and reputational risk and fifteen tertiary indicators with the scenarios of non-performing loan ratio, capital adequacy ratio, provision coverage ratio, etc. It should be noted that the indicators in Figure 11 below that we constructed are the primary covered secondary and tertiary indicators, but do not represent all factors of the secondary and tertiary indicators to which they belong.

The corresponding meanings of the three levels of indicators (program level) are described in Table 3 below.

Table 3 Description of the meanings corresponding to the three levels of indicators (program level)

Tertiary indicators (program level)	Description of the meaning of the three levels of indicators
Non-Performing Loan Ratio C_{111}	Non-performing loan balance/all loan balance*100%
Capital Adequacy Ratio C_{112}	Capital adequacy ratio = assets/risk assets
Provision coverage ratio C_{113}	Allowance for loan losses/non-performing loans*100%
Liquidity ratio C_{121}	Liquid assets/liquid liabilities*100%
Liquidity Coverage Ratio C_{122}	Liquidity coverage ratio = Qualified high quality liquid assets / Net cash outflow in the next 30 days * 100%
Leverage C_{131}	Tier 1 Capital / Total Assets * 100%
Risk-weighted assets C_{132}	Total risk-weighted assets = on-balance sheet assets × risk weights + off-balance sheet assets × conversion factor × risk weights (ratio of on-balance sheet and off-balance sheet risk-weighted assets to total assets)
Water conservation C_{141}	Tonnage of water used*(1+15%)
Nitrogen oxide emission reduction C_{142}	Nitrogen oxides can cause acid rain and higher roadside ozone concentrations
Carbon dioxide equivalent emission reductions C_{143}	Emission reduction of 1 ton of carbon (liquid or solid carbon) = emission reduction of 3.67 tons of CO2
Chemical oxygen demand reduction C_{144}	The higher the COD, the more polluted the water body is
Ammonia nitrogen emission reduction C_{145}	Ammonia nitrogen causes eutrophication in water bodies
Green Credit Loan Balance	To comply with environmental

C_{146}	testing standards, pollution control effects and ecological protection as an important prerequisite for credit approval
Return on average net assets C_{151}	Net income after tax/owner's equity
Number of graduate students and above as a percentage C_{152}	Number of graduate students and above/total number of students

5.3 Quantitative calculation results and ranking of risk indicators based on the improved hierarchical analysis-entropy method

It is worth stating that the hierarchical analysis method we used in this study is different from the classical hierarchical analysis method because the classical hierarchical analysis method itself has the limitations of low accuracy of results and too much subjectivity. In order to reduce the limitations of the subjective assignment method, although we combine objective methods in our study, we introduce the credibility of experts and identity information weights for improvement in order to essentially reduce the unreliability of the subjective assignment method, and refer to the improved hierarchical analysis method as Improved Analytic Hierarchy Process, or IAHP for short.

(1) Expert identity information weight calculation method

The original evaluation data of decision making of IAHP method need to be obtained by scoring of experts, and the credibility criteria of experts are judged from five aspects of experts' working years, education, profession, experience and titles, and the specific criteria weights are shown in Table 4 below.

Table 4 Expert rating weighting table

Indicators	weight w_i	level	score s_i
Working years	3	>30	0.8
		15-30	0.6
		<15	0.4
Education	1	Ph.d	0.8
		Master	0.6
		Bachelor	0.4
Major	2	Applied Economics	0.8
		Systems Science	0.6
		Management	0.4
Experience	3	Experience in financial risk assessment research	0.8
		No financial risk assessment research experience	0.4
Title	1	Professor	0.8
		Associate professor	0.6
		Lecture	0.4

Based on the contents of Table 4, we can calculate the credibility of the experts , as shown in Equation (12).

$$R_j = \frac{\sum_{i=1}^{5} w_i s_i}{10}, (i,j = 1, 2, 3, 4, 5) \tag{12}$$

Where i is the credibility criterion of the expert, 1-5 corresponds to the expert's length of service, education, specialty, experience and title, respectively; R_j is the credibility of the first expert j .

According to the credibility calculation formula of the expert (12), we can further calculate the weight of the expert , as shown in formula (13).

$$w_j = \frac{R_j}{\sum_{j=1}^{n} R_j} \tag{13}$$

where in equation (13) is the number of experts, and in this study five experts in the relevant fields were selected, so $n = 5$.

(2) Calculation method of four weight values

1. Expert identity information weight value

We found five experts from several universities, including Renmin University of China, Institute of Economics, Chinese Academy of Social Sciences, and Southwest University of Finance and Economics, to score the importance of 15 indicators according to the scoring rules of IAHP method in our study of the risk assessment of green fintech in Chinese banks. The basic information of the five experts is shown in Table 5 below.

Table 5 Identification information sheet for 5 experts

No.	Working years	Education	Major	Experience	Title
1	36	PH.D	Applied Economics	Experience in financial risk assessment research	Professor
2	32	PH.D	Systems Science	No financial risk assessment research experience	Professor
3	20	PH.D	Management	Experience in financial risk assessment research	Associate professor
4	27	PH.D	Systems Science	Experience in financial risk assessment research	Associate professor
5	14	PH.D	Applied Economics	No financial risk assessment research experience	Lecture

We can further derive the trustworthiness values and weight values of the experts based on the above equations (12) and (13) as shown in Table 6 below.

Table 6 Results of the calculation of experts' credibility values and weight values

No.	Reliability value R_e	Weight value w_e
1	0.800	0.244
2	0.640	0.195
3	0.640	0.195
4	0.680	0.207
5	0.520	0.159

2. Weight calculation method of IAHP method subjective empowerment method

Step 1: The comparison matrix is constructed for the indicators within each level according to equation (1), and the scoring results of the five experts are shown in Tables 1 - 5 in Annex 1.

Step 2: The five experts construct the comparison matrix for the indicators between each level (criterion level and scheme level) respectively

(1) The comparison matrix for each indicator of the "credit risk" layer is shown in Tables 6 to 10 in Annex 1.

(2) For the "Liquidity risk" layer, a comparison matrix is constructed for each indicator, as shown in Tables 11 and 15 in Annex 1.

(3) The comparison matrix for each indicator in the "market risk" layer is shown in Tables 16 and 20 in Annex 1.

(4) For the "Green Credit and Environmental Performance Risks" layer, a comparison matrix was constructed for each indicator, as shown in Tables 21 and 25 in Annex 1.

(5) A comparison matrix was constructed for each indicator in the "operational and reputational risk" layer, as shown in Tables 26 and 30 in Annex 1.

Step 3: Use Matlab program to perform hierarchical single ranking and consistency test according to equations (2) and (3) The value of each matrix is less than 0.1, and it passes the consistency test and obtains the results of the five expert weights calculation for the weights of the pairs as shown in Table 7-Table 11 below.

Step 4: Hierarchical total ranking and consistency check

The values of each matrix are all less than 0.1, and the results of the five experts' weights are obtained by the consistency test as shown in Table 7-Table 11 below for the weights of pairs, the weights of pairs, and the weights of pairs.

(1) The results of single ranking and total ranking of expert 1 are shown in Table 7.

Table 7 Hierarchical single ranking and total ranking calculation results for Expert I

	B_{1i} to A_1 weight		C_{1ij} to B_{1i} weight		C_{1ij} to A_1 weight
A_1	B_{11}	0.283	C_{111}	0.648	0.183
			C_{112}	0.122	0.035
			C_{113}	0.230	0.065
	B_{12}	0.053	C_{121}	0.667	0.035
			C_{122}	0.333	0.018
	B_{13}	0.084	C_{131}	0.250	0.021
			C_{132}	0.750	0.063
	B_{14}	0.478	C_{141}	0.050	0.024
			C_{142}	0.132	0.063
			C_{143}	0.209	0.100
			C_{144}	0.083	0.040
			C_{145}	0.142	0.068
			C_{146}	0.384	0.184
	B_{15}	0.103	C_{151}	0.750	0.077
			C_{152}	0.250	0.026

(2) The results of the hierarchical single ranking and total ranking calculations for Expert II are shown in Table 8.

Table 8 Hierarchical single ranking and total ranking calculation results for Expert II

	B_{1i} to A_1 weight		C_{1ij} to B_{1i} weight		C_{1ij} to A_1 weight
A_1	B_{11}	0.423	C_{111}	0.558	0.236
			C_{112}	0.320	0.135
			C_{113}	0.122	0.052
	B_{12}	0.101	C_{121}	0.250	0.025
			C_{122}	0.750	0.076
	B_{13}	0.253	C_{131}	0.667	0.169
			C_{132}	0.333	0.084
	B_{14}	0.151	C_{141}	0.058	0.009
			C_{142}	0.098	0.015
			C_{143}	0.221	0.033
			C_{144}	0.137	0.021
			C_{145}	0.040	0.006
			C_{146}	0.447	0.067
	B_{15}	0.072	C_{151}	0.667	0.048
			C_{152}	0.333	0.024

(3) The results of hierarchical single ranking and total ranking calculation for expert three are shown in Table 9.

Table 9 Calculated results of hierarchical single ranking and total ranking of expert three

	B_{1i} to A_1 weight		C_{1ij} to B_{1i} weight		C_{1ij} to A_1 weight
A_1	B_{11}	0.162	C_{111}	0.309	0.050
			C_{112}	0.110	0.018
			C_{113}	0.582	0.094
	B_{12}	0.286	C_{121}	0.333	0.095
			C_{122}	0.667	0.191
	B_{13}	0.423	C_{131}	0.333	0.141
			C_{132}	0.667	0.282
	B_{14}	0.088	C_{141}	0.111	0.010
			C_{142}	0.040	0.004
			C_{143}	0.175	0.015
			C_{144}	0.051	0.004
			C_{145}	0.244	0.021
			C_{146}	0.378	0.033
	B_{15}	0.042	C_{151}	0.250	0.011
			C_{152}	0.750	0.032

(4) The results of the hierarchical single ranking and total ranking calculation for Expert IV are shown in Table 10.

Table 10 Calculated results of hierarchical single ranking and total ranking of expert IV

	B_{1i} to A_1 weight		C_{1ij} to B_{1i} weight		C_{1ij} to A_1 weight
A_1	B_{11}	0.133	C_{111}	0.122	0.016
			C_{112}	0.230	0.031
			C_{113}	0.648	0.086
	B_{12}	0.076	C_{121}	0.800	0.061
			C_{122}	0.200	0.015
	B_{13}	0.240	C_{131}	0.800	0.192
			C_{132}	0.200	0.048
	B_{14}	0.502	C_{141}	0.090	0.045
			C_{142}	0.150	0.075
			C_{143}	0.053	0.027
			C_{144}	0.414	0.208
			C_{145}	0.246	0.123
			C_{146}	0.048	0.024
	B_{15}	0.049	C_{151}	0.800	0.039
			C_{152}	0.200	0.010

(5) The results of the hierarchical single ranking and total ranking calculation for Expert V are shown in Table 11.

Table 11 Calculated results of hierarchical single ranking and total ranking of expert five

	B_{1i} to A_1 weight		C_{1ij} to B_{1i} weight		C_{1ij} to A_1 weight
A_1	B_{11}	0.240	C_{111}	0.297	0.071
			C_{112}	0.540	0.130
			C_{113}	0.163	0.039
	B_{12}	0.460	C_{121}	0.750	0.345
			C_{122}	0.250	0.115
	B_{13}	0.103	C_{131}	0.333	0.034
			C_{132}	0.667	0.069
	B_{14}	0.136	C_{141}	0.184	0.025
			C_{142}	0.105	0.014
			C_{143}	0.040	0.005
			C_{144}	0.064	0.009
			C_{145}	0.085	0.012
			C_{146}	0.522	0.071
	B_{15}	0.062	C_{151}	0.333	0.021
			C_{152}	0.667	0.041

Step 5.

Based on the credibility and weight values of the five experts in Table 6, the combined weights of each indicator of the five experts in the IAHP method are derived, as shown in Figure 12 for the IAHP weights.

Roofing: The process of risk assessment for banks' green fintech business in China

Ceiling: IAHP-entropy method

Green Fintech Business Risk Indicators	Results of weight calculation for IAHP						Entropy method of weight calculation results			IAHP-entropy method of combining weight values	Weighting of indicators in descending order
	1	2	3	4	5	IAHP method weights	Information entropy	Information utility value	Entropy method weights		
C_{111}	0.183	0.236	0.050	0.016	0.071	0.080	0.428	0.572	0.096	0.088	$C_{143}=0.407$
C_{112}	0.035	0.135	0.018	0.031	0.130	0.041	0.685	0.315	0.053	0.047	$C_{146}=0.398$
C_{113}	0.065	0.052	0.094	0.086	0.039	0.046	0.777	0.223	0.038	0.042	$C_{141}=0.348$
C_{121}	0.035	0.025	0.095	0.061	0.345	0.059	0.637	0.363	0.061	0.060	$C_{152}=0.328$
C_{122}	0.018	0.076	0.191	0.015	0.115	0.048	0.621	0.379	0.064	0.056	$C_{151}=0.303$
C_{131}	0.021	0.169	0.141	0.192	0.034	0.073	0.635	0.365	0.063	0.068	$C_{144}=0.277$
C_{132}	0.063	0.084	0.282	0.048	0.069	0.070	0.697	0.303	0.052	0.061	$C_{145}=0.211$
C_{141}	0.024	0.009	0.010	0.045	0.025	0.015	0.681	0.319	0.054	0.348	$C_{142}=0.157$
C_{142}	0.063	0.015	0.004	0.075	0.014	0.026	0.287	0.713	0.121	0.157	$C_{111}=0.088$
C_{143}	0.100	0.033	0.015	0.027	0.005	0.030	0.783	0.217	0.037	0.407	$C_{131}=0.068$
C_{144}	0.040	0.021	0.004	0.208	0.009	0.041	0.513	0.487	0.081	0.277	$C_{132}=0.061$
C_{145}	0.068	0.006	0.021	0.123	0.012	0.035	0.387	0.613	0.103	0.211	$C_{121}=0.060$
C_{146}	0.184	0.067	0.033	0.024	0.071	0.058	0.738	0.262	0.044	0.398	$C_{122}=0.056$
C_{151}	0.077	0.048	0.011	0.039	0.021	0.030	0.577	0.423	0.072	0.303	$C_{112}=0.047$
C_{152}	0.026	0.024	0.032	0.010	0.041	0.017	0.639	0.361	0.061	0.328	$C_{113}=0.042$

Basement: Countermeasures and Suggestions for Risk Control of Bank's Green Fintech Business for Key Indicator Factors

Fig.12 Results of QFD-based risk assessment of green fintech business

3. Calculation results of the combination weighting AHP-entropy value method

The calculation results of the combination weights in the right wall of Figure 12 are derived according to Equation (11).

From this, we can get that the weights of the 15 indicators in descending order are: carbon dioxide equivalent emission reduction, green credit loan balance, water saving, percentage of graduate students and above, average return on net assets, chemical oxygen demand reduction, ammonia nitrogen reduction, nitrogen oxide reduction, non-performing loan ratio, leverage ratio, risk-weighted assets, liquidity ratio, liquidity coverage ratio, capital adequacy ratio, and provision coverage ratio.

6 Risk Control Measures for Green Fintech Business of Banks in China in the Era of Digital Economy

Based on the above empirical study, according to the weight size, we find five key indicators that affect the risk of green fintech business of banks in China, which are carbon dioxide equivalent emission reduction, green credit loan balance, water saving, percentage of postgraduate students or above, and average return on net assets. The following recommendations are then made based on these five key indicators.

First, in targeting CO2-equivalent emission reduction, it is suggested that banks should incorporate environmental performance indicators into their assessment system and promote specific measures such as green office and operations, non-essential video conferencing, positive and negative use of office paper, and turning off lights in office facilities and public places when people leave. In addition, banks can develop incentive policies, such as giving environmental performance bonuses for departmental CO2 equivalent emission reductions higher than the previous quarter.

Secondly, in targeting the balance of green credit loans, banks are advised to strictly screen the sectors in which they grant loans, focusing on the companies' contribution to environmental protection and sustainable development measures. Therefore, when banks select loan industries and categories, they will put more weight on energy saving and environmental protection industries rather than high pollution types of enterprises.

Thirdly, for water conservation, it is suggested that banks should make the estimated water consumption for each quarter in advance, and compare the actual water consumption with the estimated water consumption at the end of the quarter, and the departments with increased water savings should be praised and rewarded. We also encourage employees to pay extra attention to the timely shutting off of water in the restrooms and the normal use of the pantry equipment, and to repair leaks in a timely manner.

Fourth, with regard to the proportion of graduate students and above, it is suggested that the human resources department of the bank should consider the education of employees as an essential assessment criterion when recruiting employees, and increase the proportion of graduate students and above among employees.

Fifth, with regard to the average return on net assets, it is suggested that banks should continuously improve their profitability and optimize their revenue structure on the basis of ensuring social benefits, formulate strategic and tactical plans, grasp the opportunities and challenges in the market in advance, and choose appropriate investments so as to improve the overall profitability of banks.

7 Conclusion

We cleverly improved the method of risk assessment and gave risk prevention and control suggestions for the green fintech business of banks in China in the era of digital economy. The research method first introduced the quality function configuration theory for qualitative analysis, then used the improved hierarchical analysis method fused with the entropy value method to design relevant indicators, and finally constructed the indicator evaluation system. The specific conclusions are as follows.

(1) A structure of indicators for the risk assessment of fintech business was constructed by drawing on the quality function configuration theory in marketing. The AHP-entropy method was incorporated into this structure to calculate the weights of each indicator, and the applicability of the method in the risk assessment of green fintech business of banks in China was demonstrated through case studies. It is worth emphasizing that the improved hierarchical analysis method is used in this

study, introducing the credibility and identity weights of experts, assessing the credibility of experts from five perspectives, namely, the length of service, education, profession, experience and title of experts, and further calculating the identity weights of experts to make up for the too strong subjectivity of the hierarchical analysis method and improve the scientificity of the research results.

(2) Applying the theory and method to the case of green fintech business risk assessment of Chinese banks, we innovatively constructed a bank fintech business risk assessment index system in China considering the green perspective, and also verified the relationship among 15 indicators related to bank green fintech business risk, which provides ideas for the subsequent bank green financial risk assessment. In terms of research methodology, we combined the subjective assignment method with the objective assignment method, quantitatively calculated the importance of each indicator, gave the ranking results of each indicator and further verified the scientificity and rationality of the method.

(3) The combination of quantitative and qualitative approaches enhances the logic and rigor of the article and realizes the combination of research theory and practical application. Under an interdisciplinary perspective, the issue of bank financial risk is studied, contributing to the development of the field of bank financial risk, enriching the theoretical knowledge of bank finance and expanding the research literature. At the practical level, based on the importance of indicators for the control of banks' fintech business, relevant countermeasures and recommendations can also be made, and the application of theory to practice is a process worth emphasizing and illustrating. It allows banks to grasp the wind of the times and anticipate possible potential opportunities and risks in advance to achieve long-term development under the dynamic changes in the external environment, and provides a reference for the government and bank regulators in China to develop bank risk control measures, as well as a reference for international related financial risk manage

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Statement of Interest

All authors of this paper have unanimously agreed to submit this paper to your journal and will not have any other interest preference for other journals or international conferences.

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