UNIVERSIDAD COMPLUTENSE DE MADRID

FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES

TESIS DOCTORAL

Análisis del uso de las TIC en el sector de las microfinanzas: Evidencia en China

Analysis of ICT usage in microfinance sector: Evidence from China

MEMORIA PARA OPTAR AL GRADO DE DOCTORA

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Abstract

Microfinance plays a key role in combating financial exclusion and fostering entrepreneurship in developing countries. Advances in information and communication technologies (ICTs) facilitate interactive communication among individuals and fundamentally transform business operations. By providing cost-effective financial services to remote customers, ICTs unlock the full potential of microfinance. Despite the significant impact of ICTs on the microfinance industry, few studies have comprehensively explored the relationship between microfinance and ICTs.

In China, the widespread adoption of ICT-based microfinance platforms like Alipay and WeChat Pay has significantly improved access to financial services, including mobile payments, money transfers, financial management, and insurance. However, while these ICT tools and strategies promise efficiency and cost reduction for microfinance providers, addressing customer needs, preferences, and potential privacy concerns remains crucial for delivering effective financial services and retaining customers. Therefore, it is essential to analyze how ICTs can be promoted from the customer's perspective.

Chapter 2 of the dissertation aims to assess the role of ICTs in the microfinance industry through a systematic literature review using bibliometric methods. A total of 347 articles (from 1998 to 2021) were selected from the Web of Science database. Descriptive statistical analysis identified contributing institutions, countries, journals, authors, and influential publications. The co-citation and co-word analysis, presented through CiteSpace, revealed crowdfunding, P2P lending, and mobile banking as prominent topics, particularly in relation to entrepreneurship and microfinance. We also proposed that leveraging fintech, including blockchain and emerging technologies, to promote financial inclusion is a future research trend.

Building on these findings, Chapter 3 investigates user resistance to facial recognition technology (FRT) on Chinese microfinance platforms using structural equation modeling (SEM) analysis. A theoretical model was developed combining the technology paradox framework and self-efficacy theory. The study collected 418 valid questionnaires via an

online survey, indicating that self-efficacy significantly influences technology paradoxes, anxiety, and resistance. Furthermore, the relationship between technology paradoxes and anxiety varies, with users expressing greater concern over dissatisfiers like inefficiency and privacy. A positive correlation was also observed between anxiety and resistance towards facial recognition technologies on microfinance platforms. Finally, mediation analysis demonstrated that self-efficacy not only directly affects resistance but also indirectly influences it through efficiency, privacy, and anxiety.

Chapter 4 explores the impacts of customer value derived from gamification on satisfaction and customer citizenship behavior within the microfinance sector. An online survey targeting users of microfinance platforms in China was conducted to validate our theoretical framework. Partial least squares-structural equation modeling (PLS-SEM) analysis on 405 valid data sets revealed that functional and social values positively impact satisfaction, while emotional and monetary values do not significantly affect satisfaction. Additionally, satisfaction is positively associated with helpfulness, feedback, tolerance, and advocacy. The study also confirmed the mediating role of satisfaction in the relationships between functional value, social value, and customer citizenship behavior.

This thesis concludes with a summary of the findings in Chapter 5 and future research directions in Chapter 6. It provides valuable insights into the role of ICTs in microfinance and the broader financial industry. The bibliometric analysis consolidates scattered literature, identifies the most relevant sources and authors, and tracks the evolution of topics in the field. These findings benefit researchers and practitioners in understanding ICTs' application and development trends in microfinance. The empirical analysis aids in adopting facial recognition technologies and other ICTs in microfinance by revealing Chinese users' resistance mechanisms. We emphasize the importance of efficiency, privacy, and suggest initiatives for microfinance providers and policymakers to enhance transparency and user confidence. Lastly, the study supports the integration of gamified elements to enhance customer loyalty and relationships by exploring customer value from gamification in microfinance and identifying factors influencing customer citizenship behavior in gamified platforms.

Resumen

Las microfinanzas desempeñan un papel clave en la lucha contra la exclusión financiera y en el fomento del emprendimiento en los países en desarrollo. Los avances en las tecnologías de la información y la comunicación (TIC) facilitan la comunicación interactiva entre individuos y transforman fundamentalmente las operaciones comerciales. Al proporcionar servicios financieros accesibles a clientes remotos, las TIC contribuyen a que las microfinanzas desarrollen todo su potencial. A pesar del impacto significativo de las TIC en la industria de las microfinanzas, pocos estudios han explorado de manera exhaustiva la relación entre las microfinanzas y las TIC.

En China, la amplia adopción de aplicaciones basadas en TIC, como Alipay y WeChat Pay ha contribuido significativamente a mejorar el acceso a servicios financieros, como pagos móviles, transferencias de dinero, gestión financiera y seguros. Sin embargo, si bien estas herramientas y estrategias de TIC prometen eficiencia y reducción de costes para los proveedores de microfinanzas, abordar las necesidades, preferencias y posibles preocupaciones de privacidad de los clientes sigue siendo crucial para brindar servicios financieros efectivos y seguros con el objetivo de retener clientes. Por lo tanto, es esencial analizar cómo se pueden promover las TIC desde la perspectiva del cliente.

El segundo capítulo de la tesis pretende evaluar el papel de las TIC en la industria de las microfinanzas mediante una revisión sistemática de la literatura con métodos bibliométricos. Se seleccionaron un total de 347 artículos (de 1998 a 2021) de la base de datos de Web of Science. El análisis estadístico descriptivo identificó las instituciones colaboradoras, países, revistas, autores y publicaciones influyentes. El análisis de co-citación y co-palabras, presentado a través de CiteSpace, destacó los siguientes temas: el crowdfunding, los préstamos P2P y la banca móvil, especialmente en relación con el emprendimiento y las microfinanzas. También se identificó como tendencia futura de investigación aprovechar la tecnología financiera, incluidos blockchain y otras tecnologías emergentes, para promover la inclusión financiera.

Basado en estos hallazgos, el tercer capítulo se centra en la investigación de la resistencia del usuario a la tecnología de reconocimiento facial (FRT) en las plataformas de microfinanzas chinas, mediante el análisis de ecuaciones estructurales (SEM). Se desarrolló un modelo teórico que combina el marco de paradoja tecnológica con la teoría de la autoeficacia. El estudio se realizó con una muestra de 418 cuestionarios válidos realizados a través de una encuesta online, concluyendo que la autoeficacia influye significativamente en las paradojas tecnológicas, la ansiedad y la resistencia. Además, la relación entre las paradojas tecnológicas y la ansiedad varía, y los usuarios expresan mayor preocupación por factores insatisfactorios como la ineficacia y la privacidad. También se observó una correlación positiva entre la ansiedad y la resistencia. Finalmente, el análisis de mediación demostró que la autoeficacia no solo afecta directamente a la resistencia, sino que también la influye indirectamente a través de la eficiencia, la privacidad y la ansiedad.

El cuarto capítulo explora cómo el valor del cliente derivado de la gamificación impacta en la satisfacción y el comportamiento de ciudadanía del cliente en el sector de las microfinanzas. Se realizó una encuesta online dirigida a usuarios de plataformas de microfinanzas en China para validar nuestro marco teórico. El análisis de ecuaciones estructurales de mínimos cuadrados parciales (PLS-SEM) en 405 conjuntos de datos válidos, reveló que los valores funcionales y sociales impactan positivamente en la satisfacción, mientras que los valores emocionales y monetarios no afectan significativamente a la satisfacción. Además, la satisfacción se asocia positivamente con la utilidad, la retroalimentación, la tolerancia y la promoción. El estudio también confirmó el papel mediador de la satisfacción en las relaciones entre el valor funcional, el valor social y el comportamiento ciudadano del cliente.

Finalmente, la tesis concluye con una síntesis de los hallazgos del capítulo cinco y las propuestas de futuras líneas de investigación en el capítulo seis. Este estudio ofrece valiosas perspectivas sobre el papel de las TIC en las microfinanzas y en el sector financiero en general. El análisis bibliométrico consolida la literatura dispersa, identifica las fuentes y los autores más relevantes y sigue la evolución de los temas en esta disciplina científica. Estos son de gran interés para investigadores y profesionales a la hora de comprender la

aplicación de las TIC y las tendencias de desarrollo en microfinanzas. Asimismo, el análisis empírico ayuda a adoptar las tecnologías de reconocimiento facial y otras TIC en el área de microfinanzas al revelar los mecanismos de resistencia de los usuarios chinos a las tecnologías de reconocimiento facial. Destacamos la importancia de la eficiencia y la privacidad, y sugerimos iniciativas para que los proveedores de microfinanzas y los responsables políticos mejoren la transparencia y la confianza de los usuarios. Por último, nuestro estudio apoya la integración de elementos de gamificación para mejorar la fidelidad y la relación con los clientes, explorando el valor para el cliente de la gamificación en microfinanzas e identificando los factores que influyen en el comportamiento ciudadano del cliente en las plataformas de gamificación.

Chapter 1. Introduction

Chapter 1. Introduction

1.1 Backgrounds

In the last 20 years, microfinance has moved from a promise to a reality and remarkable development can be seen in the field (Gutiérrez-Nieto & Serrano-Cinca, 2019). As one of the microfinance providers (MFPs), microfinance institutions (MFIs) have been at the forefront of poverty alleviation efforts around the world (Iyengar et al., 2010). In particular, the significance of microfinance industry in the Chinese context has grown immensely as about 30 percent of the Chinese population is excluded from conventional banking channels (Zreik et al., 2023).

Microfinance encompasses a range of financial services (e.g., deposits, loans, payment services, money transfers, insurance, savings, micro-credit) tailored for individuals who are typically excluded from mainstream banking due to factors such as low income, limited collateral, or a lack of formal financial history (Hermes & Lensink, 2011; Kumar et al., 2015). The China Association of Microfinance (CAM) defines microfinance as the provision of financial services specifically designed for the middle and low-income segments that often face difficulties accessing loans from traditional banks (Wang, 2013). In China, microfinance services have evolved beyond just microcredit to include offerings such as microsavings, microinsurance, payment solutions, and investment opportunities, catering to the diverse financial needs of this population.

Additionally, advances in information and communication technologies (ICTs) facilitate interactive communication among individuals (Mwela, 2014) and even fundamentally change the way businesses operate (Iyengar et al., 2010). By extending financial services to distant customers cost-effectively (Singh & Padhi, 2015), ICTs make it possible to realize the maximum potential of microfinance (Attali, 2000). Mobile banking, for example, allows individuals in remote or rural areas to access a range of financial services using their mobile phones. Additionally, digital platforms reduce the need for costly physical bank

branches, especially in sparsely populated areas. This cost-efficiency enables MFIs to serve low-income individuals at a lower cost.

ICTs represent a wide range of communication devices, application software, and various related services. Specifically, ICT tools used in the microfinance sector consist of mobile phones, mobile banking applications, faxes, electronic mail, electronic point-of-sale (E-POS), management software (e.g., form-filling software), bank websites, and other internet-based services (Adebayo et al., 2017; Ali et al., 2021; Rozzani et al., 2013). Besides, ICTs are also classified by their purpose. For example, Ashta (2010) classified technologies used in microfinance into two types: tools to provide information to customers and microfinance, tools for management and support. Unlikely, the European Microfinance Network proposed that they should be divided into three types: client-facing technologies, process automation technologies, and technologies for running the business (Rozzani et al., 2013).

A series of recent advancements, such as online platforms and mobile payments, are updating the way financial services are delivered (Bruton et al., 2015). In China, the widespread adoption of ICT-based microfinance platforms like Alipay, WeChat Pay, and JD Finance, has notably facilitated individuals' access to various financial services, including mobile payments, money transfers, financial management, and insurance (Zhang & Chen, 2019). Generally, these platforms based on ICT tools (e.g., computers, the internet, websites, mobile devices) deliver financial services and provide both group and individual lending (Moro-Visconti, 2021). They are gradually replacing traditional credit and are even inseparable from the daily consumption of individuals.

These platforms have been updating their functions and applications by incorporating a range of digitalization strategies into the platforms (Liu, 2015; Zhong & Nieminen, 2015). For instance, facial recognition technology (FRT) is increasingly used by online microfinance platforms in China to extract and recognize the borrowers' facial features to assess their credibility and predict loan repayment performance (Chen & Xu, 2019). Another example is the gamification strategies embraced by these platforms to enhance user engagement and overall user experiences. The infusion of playful elements, such as

rewards, challenges, and interactive interfaces, aims to create a dynamic and enjoyable financial experience for users (Yathiraju & Dash, 2023).

These ICT tools and digitalization strategies can help microfinance providers improve efficiency, reduce costs, and alter the way individuals access financial services (Moro-Visconti, 2021). The great contribution of ICTs to microfinance also has been extensively highlighted by previous studies (Etim, 2013; Kauffman & Riggins, 2012; Mwashiuya & Mbamba, 2020; Ndungu & Moturi, 2020; Wamai & Kandiri, 2015). Therefore, to provide more efficient and effective financial services, it is necessary to analyze whether and how ICTs can be promoted, especially from the customer's perspective.

As pointed out by Brinckerhoff (2018), FRT introduces privacy risks by collecting and storing customers' biometric data. In fact, the Chinese public hesitates to use FRT or even opposes it. According to a survey in 2019, 75% of over 6000 Chinese citizens preferred traditional recognition methods rather than FRT (Kostka et al., 2021). Similarly, the latest investigation in 2021 revealed that 87% of over 1500 respondents opposed FRT use. Furthermore, research on the impact of digitization strategies such as gamification is controversial (Bekk et al., 2022). For example, Eisingerich et al. (2019) argue that gamification strategies have a positive impact on customer engagement. Conversely, Leclercq et al. (2018) contend that instances where gamification fails can have a detrimental effect on the product or service. Therefore, further insights into the factors influencing ICT adoption by clients and their impact as well as its effects are critical for MFIs.

In the past decade, considerable research effort has been devoted to the field of microfinance, including the creation of social capital, alleviation of poverty, empowerment of women (e.g., Iyengar et al., 2010; Strøm et al., 2014), and the sustainability, efficiency, outreach and the trade-off between outreach and profitability of the MFIs (e.g., Baland et al., 2017; Giné & Karlan 2014; Hermes & Lensink, 2011; Lebovics et al., 2016; López-Sánchez & Urquia-Grande, 2023; Mirpourian et al., 2016; Simeyo et al., 2013; Wagner & Winkler, 2013).

Recently, the focus of microfinance has shifted from its impacts on clients to the microfinance itself (Gutiérrez-Nieto & Serrano-Cinca, 2019). Besides, emerging topics are Islamic microfinance, financial inclusion, and social entrepreneurship (e.g., Amran et al., 2014; Dutta & Banerjee 2018; Newman et al., 2017). Classic topics including task drift, efficiency, outreach, and sustainability still exist, many of which now use panel data models (Lebovics et al., 2016).

However, research on the relationship between the use of ICTs and microfinance is relatively scarce and has mainly been conducted through qualitative descriptions. For example, Iyengar et al. (2010) discuss five main challenges that arise in implementing ICT within MFIs and explore how these challenges are overcome by MFIs that operate in various locations around the world. Etim (2013) researches the application of mobile technology for microfinance delivery in Sub-Saharan Africa (SSA) using a questionnaire method and the result shows that the application of mobile telephones in SSA is impacting indigenous development, information sharing, and the support provided by microfinance services. Kauffman and Riggins (2012) discuss the role and impact of ICT on the microfinance industry at different levels (customers, microfinance institutions, donors, and the microfinance industry) and analyze the effects and transformations of the value chain, which are considered to be a foundation to identify the extent to which ICT promotes the sustainability of microfinance.

The existing body of research on microfinance has made strides in exploring the interplay between ICT and microfinance. However, a noticeable gap persists in understanding the factors influencing ICT usage from the customer's perspective, particularly in elucidating customer attitudes and retention, which remain unclear in the context of microfinance. This gap is especially pronounced in China, where there is a dearth of in-depth research in this crucial area.

Moreover, while prior studies have provided valuable insights into various aspects of microfinance over the past decade, there remains a glaring shortage of systematic research addressing the role and current status of ICTs within the microfinance sector. This gap in

knowledge formation underscores the need for organized and comprehensive research efforts to fill these critical gaps and advance our understanding of ICT's impact on microfinance.

1.2 Research objectives

Against the above background, this thesis aims to comprehensively examine the role of ICTs in the microfinance sector, particularly focusing on the Chinese context. The research objectives are as follows:

Objective 1: Investigate the interaction between ICTs and microfinance:

Through a bibliometric analysis, we try to provide a comprehensive overview of the interactions between ICTs and microfinance by identifying influential works, and trends in the research field and analyzing the contributions of various institutions, countries, journals, and authors to the microfinance and ICTs research domain.

Objective 2: Examine customer-oriented technologies:

We aim to evaluate the impact of customer-oriented technologies, specifically FRT and gamification strategies, on microfinance platforms. Specifically, we investigate the factors influencing user resistance to FRT and analyze the influence of customer value derived from gamification strategies on customer citizenship behaviors (CCB) within microfinance platforms.

Objective 3: Provide practical insights:

We intend to provide insights and recommendations to MFIs and policymakers to facilitate ICT adoption and implementation, with a focus on improving efficiency, reducing costs, and enhancing customer experience and loyalty.

1.3 Research structure

This thesis includes six chapters involving a brief introduction, three closely intertwined studies, a discussion of findings as well as limitations, and future research. The main elements of these chapters are summarized below:

Chapter 2

Publication: Research into microfinance and ICTs: A bibliometric analysis. *Evaluation and Program Planning* (SSCI, JCR Q2), 2022, vol. 97, p. 102215.

In the first stage, this study aims to provide a comprehensive overview of the interactions between ICTs and microfinance. Several recent studies have explored the relationship between ICTs and microfinance, investigating aspects such as risk management, work efficiency, client management (Singh & Padhi, 2015), performance of microfinance (Seoudi, 2015), market structure (Riggins & Weber, 2016), as well as the factors influencing the acceptance of ICTs among microfinance (Homaid, 2019). However, to date, no study has systematically reviewed the relationship between microfinance and ICTs. While there have been several reviews in the microfinance field (Brau & Woller, 2004; Gutiérrez-Nieto & Serrano-Cinca, 2019; Hermes & Hudon, 2018; Rooyen et al., 2012), few studies have systematically examined the relationship between microfinance and ICTs. Research focusing on a specific aspect of microfinance, particularly from the perspective of ICTs, remains relatively rare.

This study is a pioneer in examining the role of ICTs in the microfinance sector with bibliometric analysis. A bibliometric review enables us to figure out the most influential works and the tendencies of the research field. Introducing quantitative analysis into a literature review and mapping the research also allows analysts to express opinions without subject bias. Unlike previous bibliometric analyses, the present study is not limited to providing bibliometric statistics but also presents the whole knowledge structure and evolution based on science mapping. Existing literature has provided comprehensive overviews of microfinance in general, but research on a specific aspect of microfinance is relatively rare. In particular, overviews of the relationship between microfinance and ICTs are often overlooked. Additionally, given that many previous studies often focused on topics like sustainability, efficiency, performance, and outreach without taking ICTs into consideration, this study is also an important complement to the rare microfinance and ICT research.

Specifically, this paper aims to address the following research questions:

RQ1: What are the growth trends in publications and citations for microfinance and ICT research?

RQ2: Which institutions, countries, journals, and authors have made outstanding contributions to microfinance and ICT research, and what are the influential studies?

RQ3: What are the hot topics and trends in the research domain of microfinance and ICTs?

To address these research questions, a total of 347 samples (from 1998 to 2021) were selected from the Web of Science database with reference to the guidelines of the systematic review. The methods used in this paper include descriptive statistical analysis, co-citation analysis, and co-word analysis. In particular, to perform co-citation analysis and co-word analysis, three main types of visualization—cluster views, timezone views, and timeline views, were all presented through the CiteSpace software.

Based on the bibliometric analysis, this paper identified the contributing institutions, countries, journals, authors as well as influential studies. For example, ranked by the number of institutions, the most active countries studying microfinance and ICT tools are the United States, China, and France. Europe as a whole has contributed a lot in this field. Furthermore, it is found that crowdfunding, P2P lending, and mobile banking are the major topics. Of particular interest is the relationship between these platforms and entrepreneurship. We also proposed that applying fintech, especially blockchain, and other emerging technologies, to promote financial inclusion is one of the future research trends.

This study makes significant contributions by bringing together scattered literature in the field and identifying critical sources, authors, literature, and topics of the evolution of the discipline. These findings assist researchers, policymakers, and evaluators related to microfinance and ICTs in understanding the application and development trend of ICTs in the microfinance sector. It allows researchers to understand the existing knowledge and focus of research in this domain. In particular, the analyses of hot topics and research prospects provide direction for future scholars. Additionally, this study motivates practitioners to recognize the important role of ICTs in the microfinance industry and make

full use of ICTs to achieve sustainability and financial inclusion. They will benefit from the findings of relevant studies identified by this research by discussing and assessing ICT issues analyzed by these documents. In light of these insights, the following chapter delves deeper into the specific practical implementation of ICTs in the microfinance sector.

Chapter 3

Publication: How technology paradoxes and self-efficacy affect the resistance of facial recognition technology in online microfinance platforms: Evidence from China. *Technology in Society* (SSCI, JCR Q1), 2022, vol. 70, p. 102041.

Drawing from the conclusions in Chapter 2, our attention turns to examining the integration of customer-oriented technologies within microfinance platforms. As a critical element of AI technologies, FRT has seen remarkable developments in the past few years. It is also finding its way into the finance sector as a robust identification and authentication method. In particular, FRT has been used by most microfinance platforms in China to support their online transactions. However, like many emerging technologies, FRT has turned out to be a controversial technology and is faced with challenges. Although security, accuracy, and convenience have been emphasized, there has been an increase in discussions about its disadvantages.

According to Brinckerhoff (2018), FRT introduces privacy risks by collecting and storing customers' biometric data. Nevertheless, some studies have suggested that Chinese users care more about convenience than privacy. For instance, Che et al. (2021) found that the rapid adoption of FRT in China is related to Chinese people's low level of concern for privacy protection through a comparative analysis. That means Chinese resistance to FRT may not only be attributed to their privacy concerns. Apart from further verifying whether privacy-related factors are relevant, it is necessary to take other factors into consideration, such as functional factors (like efficiency) and psychological factors (like self-efficacy).

Therefore, the current study employed the technology paradox framework (Jarvenpaa & Lang, 2005; Mick & Fournier, 1998) and expanded it by introducing self-efficacy theory. Specifically, this research aims to appraise the degree to which technology paradoxes

(efficiency/inefficiency and private/public) and self-efficacy influence users' anxiety and resistance toward FRT on microfinance platforms. Our research framework includes the following variables—self-efficacy, technology paradoxes, anxiety, and resistance. Technology paradoxes here are comprised of efficiency, private, inefficiency, and public. Based on prior theories and studies, we propose the following hypotheses:

H1. Self-efficacy has positive associations with the satisfiers of technology paradoxes.

H1a. Self-efficacy has a positive association with efficiency.

H1b. Self-efficacy has a positive association with private.

H2. Self-efficacy has negative associations with the dissatisfiers of technology paradoxes.

H2a. Self-efficacy has a negative association with inefficiency.

H2b. Self-efficacy has a negative association with public.

H3. Self-efficacy has a negative association with anxiety.

H4. Self-efficacy has a negative association with resistance.

H5. The satisfiers of technology paradoxes have negative associations with anxiety.

H5a. Efficiency has a negative association with anxiety.

H5b. Private has a negative association with anxiety.

H6. The dissatisfiers of technology paradoxes have positive associations with anxiety.

H6a. Inefficiency has a positive association with anxiety.

H6b. Public has a positive association with anxiety.

H7. Anxiety has a positive association with resistance.

An online survey was conducted to explore the antecedents influencing the resistance of FRT, and the target participants were those who had experience of using the microfinance platforms in China. After filtering, 418 of the 542 questionnaires that were distributed were found to be valid. Subsequently, the two-step procedure of structural equation modeling (SEM) analysis was performed using AMOS 24 and SPSS 23. First, we examined the

measurement model based on confirmatory factor analysis (CFA), including model fit indices, reliability, convergent validity, and discriminant validity. Afterward, we evaluated the structural model by testing our hypotheses. In addition, the mediating effects of technology paradoxes and anxiety between self-efficacy and resistance were tested.

This study demonstrates that self-efficacy significantly affects technology paradoxes, anxiety, and resistance. Moreover, it suggests that the relationship between technology paradoxes and anxiety varies, and users are more concerned about the dissatisfiers of technology paradoxes (inefficiency and public). Besides, a positive correlation was found between anxiety and resistance. Finally, the results of the mediating effects test show that self-efficacy can not only directly affect resistance, but also indirectly influence it through efficiency, public, and anxiety.

Our study is a pioneer in evaluating the role of FRT in the microfinance context, especially microfinance customers' resistance toward FRT. It adds to the body of knowledge by creating a theoretical model that integrates the technology paradox framework and self-efficacy theory. It helps microfinance providers understand the paradoxes experienced by FRT users and take corresponding measures. Also, it raises awareness of the importance of users' confidence or self-efficacy in using FRT. Moreover, technology designers can benefit from this research by getting a better understanding of users' needs, thereby improving FRT performance and promoting its usage. Building on these insights, the subsequent chapter delves into an exploration of gamification strategies within microfinance platforms.

Chapter 4

Publication: The role of gamification in customer citizenship behavior on China's microfinance platforms. *Finance Research Letters* (SSCI, JCR Q1), 2024, vol. 63, p. 105359.

While gamification strategies gain traction among microfinance institutions for customer attraction and retention, the customer value they bring and their overall impacts have been insufficiently explored. Customer value has been suggested to play a vital role in increasing

customer satisfaction and fostering a positive customer relationship with a product or service (Gallarza et al., 2019; Xu et al., 2015). Therefore, this study extends this understanding to the gamified microfinance setting, where functional, social, emotional, and monetary values play unique roles in shaping user perceptions.

Apart from engagement and loyalty to products and services, customers have been found to exhibit customer citizenship behaviors (CCB), such as helping other customers, offering feedback to improve service delivery, and making recommendations to friends or family (Groth, 2005). In fact, the growing significance of CCB in value creation has propelled it to the forefront within the financial sector. While existing research has started to explore the effects of gamification on user engagement (Golrang & Safari, 2021; Lai & Langley, 2023; Raza et al., 2023), research on CCB within the financial domain is surprisingly scarce.

Thus, this study aims to explore the influence of gamification-induced customer value on CCB, with a specific focus on the mediating role of satisfaction. In particular, four distinct dimensions of consumers' gamified customer value are employed: functional value (FV), social value (SV), emotional value (EV), and monetary value (MV). Additionally, the concept of CCB in this study encompasses aspects such as helping, feedback, tolerance, and advocacy. Following the existing theoretical foundation, we pointed out the following hypotheses:

H1. FV is positively correlated with satisfaction with microfinance platforms.

H2. SV is positively correlated with satisfaction with microfinance platforms.

H3. EV is positively correlated with satisfaction with microfinance platforms.

H4. MV is positively correlated with satisfaction with microfinance platforms.

H5. Satisfaction with microfinance platforms is positively correlated with helping.

H6. Satisfaction with microfinance platforms is positively correlated with feedback.

H7. Satisfaction with microfinance platforms is positively correlated with tolerance.

H8. Satisfaction with microfinance platforms is positively correlated with advocacy.

Our data were collected from a reputable survey platform in China and included individuals well-versed in online microfinance platforms. To ensure questionnaire relevance, we refined item wording based on pre-test feedback. The formal questionnaire, comprising 20 questions, addressed distinct constructs, with each question focusing on specific aspects. Through meticulous data quality measures, such as setting attention-checking questions and manually screening for logical consistency, we ultimately obtained 405 valid samples. Our research involved a two-step process performed by SmartPLS 3.3.9: initially assessing the measurement model to scrutinize reliability, convergent validity, and discriminant validity, followed by hypothesis testing to thoroughly examine the structural model.

The analysis reveals that functional and social values positively impact satisfaction, while emotional and monetary values do not exhibit a significant relationship with satisfaction. Additionally, satisfaction is positively associated with helpfulness, feedback, tolerance, and advocacy. More importantly, this study confirms the mediating role of satisfaction in the relationships between FV, SV, and CCB.

This study enhances our understanding of the complex interplay between customer value, satisfaction, and citizenship behavior. This finding underscores that users of microfinance platforms prioritize the perceived utility and social relevance brought about by gamification. In light of this, microfinance providers have the opportunity to enhance customer satisfaction by strategically focusing on these two dimensions of value, thereby fostering a more tailored and enriched customer experience. Microfinance providers could work on developing business strategies for customer satisfaction, which not only retains loyal customers but also encourages them to actively contribute to these platforms through helping, feedback, tolerance, and advocacy.

Chapter 5 and Chapter 6

This thesis concludes with a comprehensive discussion and summary of the findings presented in Chapter 5. This study offers valuable insights into the role of ICTs in both microfinance and broader financial industries. At first, our bibliometric analysis makes significant contributions by bringing together scattered literature in the field and identifying

critical sources, authors, literature, and topics of the evolution of the discipline. These findings assist researchers and practitioners related to microfinance and ICTs in understanding the application and development trend of ICTs in the microfinance sector. Our subsequent empirical analysis facilitates the adoption of FRT and other ICTs in microfinance. By integrating the self-efficacy theory into the technology paradox framework, our research elucidates the mechanisms of Chinese users' resistance to FRT usage. It highlights the importance of efficiency and privacy while suggesting initiatives for microfinance providers and policymakers to enhance transparency, data control, and user confidence. Finally, this study contributes significantly by exploring diverse customer values from gamification in microfinance and identifying antecedents of CCB in gamified platforms. Our findings support integrating gamified elements into microfinance platforms, enhancing customer loyalty, and creating additional value through customer relationships.

While this study significantly advances the understanding of ICTs in microfinance, several limitations warrant attention. These limitations and future research directions are presented in Chapter 6. The primary focus on the Chinese microfinance context limits generalizability to other regions, highlighting the need for comparative studies across diverse socio-economic and cultural settings. Expanding the sample size and including more recent publications beyond 2021 would enhance the robustness and relevance of the findings. Additionally, broadening the scope to encompass a wider array of ICT tools, such as blockchain and AI, could offer a more comprehensive view. Adopting longitudinal approaches and incorporating qualitative methods would provide deeper insights into customer experiences and the evolving dynamics of ICT adoption. Future research should also explore the impact of ICTs on financial inclusion for underserved populations, the influence of regulatory frameworks, and the importance of user-centric design in enhancing microfinance services.

Chapter 2. Research into microfinance and ICTs: a bibliometric analysis[1]

[1] Aiping Liu, et al. Research into microfinance and ICTs: A bibliometric analysis. **Evaluation and Program Planning** (SSCI, JCR Q2), 2022, vol. 97, p. 102215. *https://doi.org/10.1016/j.evalprogplan.2022.102215*

Chapter 2. Research into microfinance and ICTs: a bibliometric analysis

Abstract

Information and communication technologies (ICTs) play an ever-increasing role in improving the efficiency, profitability, and sustainability of microfinance institutions. This paper aims to assess the role of ICTs in the microfinance industry by systematically reviewing the literature with bibliometric methods. In this research, a total of 347 samples (from 1998 to 2021) were selected from the Web of Science database according to the guideline of the systematic review. By performing descriptive statistical analysis, the contributing institutions, countries, journals, authors, as well as influential publications were identified. In the co-citation and co-word analysis section, three primary types of visualization——cluster views, timezone views and timeline views, were all presented through CiteSpace. It turns out that crowdfunding, P2P lending and mobile banking have been the favorite topics. A central issue is the role of these platforms in entrepreneurship. We also proposed that applying fintech, especially blockchain and other emerging technologies, to promote financial inclusion is one of the future research trends. The findings of this study will be of interest to researchers, managers, policymakers and evaluators and facilitate them to make well-informed decisions in their respective domains.

Keywords: microfinance, information and communication technologies (ICTs), bibliometric analysis, systematic review.

2.1 Introduction

Remarkable development has been seen in the microfinance industry over the past decade. Microfinance providers (MFPs)——both microfinance institutions (MFIs) and traditional banks play a crucial role in poverty reduction and economic development (Kauffman & Riggins, 2010). However, they have to balance outreach and sustainability due to the increasingly competitive environment (Kauffman & Riggins, 2012). By extending financial services to distant customers cost-effectively (Singh & Padhi, 2015), information and communication technologies (ICTs) provide an opportunity to deal with this situation. With the advent of emerging technologies, the great potential of microfinance will also be realized (Attali, 2000). ICTs can not only help achieve environmental sustainability (Wu et al., 2018; Wu et al., 2016) but also change the way businesses operate (Iyengar et al., 2010) and facilitate business sustainability (Yanti et al., 2021). The financial sector is no exception. A series of recent advancements, such as online platforms and mobile apps, are updating the way financial services are delivered (Bruton et al., 2015). Therefore, it is worthwhile to explore the relationship between microfinance and ICTs. Furthermore, the outstanding contribution of ICTs in the fight against the Covid-19 pandemic also results in an urgent need to understand their role in the microfinance industry better.

ICTs represent a wide range of communication devices, application software, and various related services. Specifically, ICT tools used in the microfinance sector consist of mobile phones, mobile banking applications, fax, electronic mails, electronic point-of-sale (E-POS), management software (e.g., form-filling software), bank websites, and other internet-based services (Adebayo et al., 2017; Ali et al., 2021; Rozzani et al., 2013). Additionally, they are also classified by their purpose. For example, Ashta (2010) classified technologies used in microfinance into two types: tools to provide information to customers and microfinance, tools for management and support. However, the European Microfinance Network proposed that they are should be divided into three types: client-facing technologies, process automation technologies and technologies for running the business (Rozzani et al., 2013). Moreover, Njihia (2019) claimed that ICTs are mostly used in financial management, marketing management and human resource departments.

Until quite recently, an increasing number of studies have attempted to explore the relationship between ICTs and microfinance. Singh and Padhi (2015), for example, assessed the impact of ICTs on risk management, work efficiency and client management of MFIs through a case study. Simultaneously, Seoudi (2015) examined the relationship between ICTs and the performance of microfinance with an empirical method. Besides, Riggins and Weber (2016) explored the impact of ICT on the intermediation market structure of the microfinance sector with experimental research methods. Adebayo et al. (2017) identified the ICT devices used in the Nigerian microfinance sector through 126 structured questionnaires. The latest study was carried out by Homaid (2019), which examined the factors influencing the acceptance and usage of ICTs among microfinance employees in Yemen based on the Technology Acceptance Model (TAM). However, to date, no study has systematically reviewed the relationship between microfinance and ICTs. Although there have been some reviews in the microfinance field (Brau & Woller, 2004; Gutiérrez-Nieto & Serrano-Cinca, 2019; Hermes & Hudon, 2018; Rooyen et al., 2012), few of them addressed issues from the ICTs perspective. This study is a pioneer to examine the role of ICTs in the microfinance sector with bibliometric analysis. Unlike previous bibliometric analyses, the present study is not limited to providing bibliometric statistics but also presents the whole knowledge structure and evolution based on science mapping. Existing literature has provided comprehensive overviews of microfinance in general, but research on a specific aspect of microfinance is relatively rare. In particular, overviews of the relationship between microfinance and ICTs are often overlooked. Additionally, given that many previous studies often focused on topics like their sustainability, efficiency, performance and outreach without taking ICTs into consideration, this study is also an important complement to the rare microfinance and ICTs research.

Consequently, there is a need to provide a comprehensive overview of the relationship between ICTs and microfinance. To achieve this goal, the current study seeks to systematically review the research of this field by employing the bibliometric technique. A bibliometric review enables us to figure out the most influential works and the tendency of the research field. By introducing quantitative analysis into a literature review and mapping

the research, it also allows analysts to express opinions without subject bias. Despite these benefits of this method, it is rarely applied to the microfinance field (Akter et al., 2021; Gutiérrez-Nieto & Serrano-Cinca, 2019; Zaby, 2019). Hence, this paper aims to address the following research questions:

RQ1: What are the growth trends in publications and citations for microfinance and ICTs research?

RQ2: Which institutions, countries, journals and authors have made outstanding contributions in microfinance and ICTs research, and what are the influential studies?

RQ3: What are the hot topics and trends in the research domain of microfinance and ICTs?

To address these research questions, a total of 347 samples (from 1998 to 2021) were selected from the Web of Science database with reference to the guideline of the systematic review. Besides, to perform co-citation analysis and co-word analysis, three main types of visualization——cluster views, timezone views and timeline views, were all presented through the CiteSpace software. Based on the bibliometric analysis, this paper identified the contributing institutions, countries, journals, authors as well as influential studies. For example, ranked by the number of institutions, the most active countries studying microfinance and ICT tools are the United States, China and France. Europe as a whole has contributed a lot in this field. Furthermore, it is found that crowdfunding, P2P lending and mobile banking are the major topics. Of particular interest is the relationship between these platforms and entrepreneurship. We also proposed that applying fintech, especially blockchain and other emerging technologies, to promote financial inclusion is one of the future research trends.

This study makes significant contributions by bringing together scattered literature in the field and identifying critical sources, authors, literature and topics evolution of the discipline. These findings assist researchers, policymakers and evaluators related to microfinance and ICTs in understanding the application and development trend of ICTs in the microfinance sector. It allows researchers to understand the existing knowledge and focus of research in this domain. In particular, the analyses of hot topics and research

prospects provide direction for future scholars. Evaluators for research can apply the findings to evaluate the outstanding researchers, the promising funding streams and themes, and to assess the outcomes of prior investments. Additionally, this study motivates practitioners to recognize the important role of ICTs play in the microfinance industry and make full use of ICTs to achieve sustainability and financial inclusion. They will benefit from the findings of relevant studies identified by this research by discussing and assessing ICT issues analyzed by these documents. On the other hand, practitioners like managers, policymakers, financial planners and evaluators, and fintech designers will be particularly interested in the results from the co-citation analysis and co-word analysis. That's because the emerging trends and topics from these analyses will facilitate them to design technology programs, choose ICT products, make ICT investment plans, and evaluate the outcomes of investment.

The organization of the paper is as follows: after this introduction, Section 2 introduces the material and methods used in this study, including literature resources, analysis methods and visualization tools. Section 3 presents and analyzes the results on the basis of descriptive statistical analysis, co-citation analysis and co-word analysis. Section 4 summarizes and discusses the findings to conclude the research.

2.2 Material and methods

2.2.1 Literature resources and samples

The database we used to collect samples is the Web of Science Core Collection, which compiles world-class academic journals, books, proceeding materials, etc. It is well known that the Web of Science database is one of the most worldwide and authoritative databases (Analytics, 2020; Norris & Oppenheim, 2007). Compared with Google Scholar, it is more suitable for complex searches for co-citation analysis. In addition, Scopus was also not considered because some references in publications were not normalized enough (Leydesdorff et al., 2010). The Web of Science database encompasses over 15,000 high-quality journals and 50,000,000 publications classified into 251 subject categories and 151 research fields (Merigó & Yang, 2017). The main part of the Web of Science database is

Core Collection which contains more than 20,000 journals plus books and conference proceedings across 254 subject disciplines with nearly 75 million records (Birkle et al., 2020; Singh et al., 2021). As a consequence, to ensure the quality of the research samples, the Web of Science database was selected as our data source.

In order to obtain comprehensive and representative samples, keyword selection is crucial. Given that our research objectives include ICTs and microfinance, the keywords were first divided into two keyword groups——keywords representing microfinance and keywords representing ICTs. Among the keywords related to ICTs, there are both ICT tools (e.g., "computer", "mobile phone") and ICT-based platforms (e.g., "crowdfunding", "P2P lending"). After confirming the keywords, we performed the search by the "topic", which covers "title", "abstract" and "keywords" at the same time. Table 2.1 presents the search tems for "microfinance" and "ICTs" in detail.

Table 2.1 Search terms

Search Terms for "Microfinance"	"microfinance" (including "micro finance", "micro-finance"), "microcredit" (including "micro-credit", "micro credit"), "microbanking" (including "micro-banking", "micro banking"), "microlending" (including "micro lending", "micro-lending"), "microsaving" (including "micro-saving", "micro saving"), "microinsurance" (including "micro insurance" "micro-insurance").
Search Terms for "ICTs"	"IT", "ICT", "ICTs", "technology", "innovation", "fintech", "artificial intelligence", "robot", "machine", "electronic", "software", "computer", "telephone", "mobile phone", "smartphone", "telecommunication", "internet", "online", "website", "digital", "mobile banking", "mobile payment", "mobile money", "peer-to-peer", "P2P", "crowdfunding", "blockchain", "cashless payment", "E-banking", "paypal", "Alipay", "point of sale".

Source: own elaboration

Initially, 4,652 and 1,499,576 records were found, respectively, by searching the two groups of keywords. Then, a total of 1,901 records were collected by combining these two sets of data using the search string "and" in the Web of Science. However, considering they are not all related to the research topic, it is necessary to screen and exclude irrelevant documents. After screening all the papers based on their titles, abstracts, keywords and even full text (if necessary), we excluded: papers without full text, duplicate papers, and irrelevant papers. For instance, many papers appearing in the initial results, with titles like "The mobile street food service practice in the urban economy of Kumba, Cameroon" (Acho‐Chi, 2002) and

"Towards Better Supply Chain Management through Micro-Finance: a Case Study for Banana Production" (Irianto & Poernomo, 2008), were utterly irrelevant to our subject. Besides, while it covers the topic of both technology and microfinance, some papers have different meanings. For example, the paper with the title "The impact of microcredit on agricultural technology adoption and productivity: Evidence from randomized control trial in Tanzania" (Nakano & Magezi, 2019) explained the relationship between agricultural technology use and microfinance instead of the adoption of technology in microfinance.

At last, a total of 347 documents, which were closely associated with the topic, were added to our samples. These samples include articles, book chapters, reviews, proceeding papers, and the like during the period from 1998 to 2021 (until March 9, 2021). Here 1998 is considered to be the starting year since the first paper regarding our topic is from that year in the Web of Science database.

2.2.2 Data analysis and visualization

The bibliometric analysis technique was eamployed for this paper. It is characterized as a complement for meta-analysis and qualitative structured literature reviews by introducing a quantitative approach to evaluate and review publications (Zupic & Čater, 2015). Compared with narrative literature reviews, bibliometric analysis allows researchers to express opinions without subject bias. More importantly, it is particularly useful in studying the current state and the development trend of a knowledge domain. This method has been increasingly used in a wide variety of disciplines and introduced into the microfinance field. For example, both Gutiérrez-Nieto and Serrano-Cinca (2019) and Zaby (2019) have applied bibliometric analysis to track the evolution of microfinance research.

To carry out the bibliometric analysis, the methods used in this paper include a. The descriptive statistical analysis enables us to identify contributing journals, authors, and institutions (Liu et al., 2020), as well as influential publications by citations. Co-citation analysis and co-word analysis, on the other hand, reveal the intellectual structure and dynamics of research topics and predict the direction of future research (Leung et al., 2017; Tan Luc et al., 2020; Walter & Ribière, 2013). Co-citation analysis is a science mapping approach that implies documents that are frequently co-cited are thematically similar

(Donthu et al., 2021; Hjørland, 2013). Co-citation is defined as an occurrence in which two publications are cited together by another publication (Wang et al., 2016). In other words, if both articles A and B are cited by article C, then articles A and B have a co-citation relationship. Similarly, based on the sharing of keywords between publications, the co-word analysis assumes that keywords that frequently occur together are connected thematically (Arroyo Esteban et al., 2022).

Moreover, the co-authorship analysis was also utilized to explore the cooperative relationship between authors and institutions. Once two authors publish an article together, their relationship is established. In the light of the authors' institutional affiliations, co-author analysis can also provide evidence of cooperation on the level of institutions and countries (Zupic & Čater, 2015).

Among a variety of software tools for visualization, such as Bibexcel, CiteSpace, BiblioMaps, CitNetExplorer, SciMAT, Sci2 Tool, VOSviewer (Cobo et al., 2011; Moral-Muñoz et al., 2020), CiteSpace was chosen to visualize the results of this study considering its powerful functions, especially in cluster analysis. By performing cluster analysis on references and keywords, emerging trends and hot topics can be detected (Chen, 2006). In this paper, three primary visualization modes——cluster views, timezone views and timeline views, were all presented.

2.3 Results

2.3.1 Descriptive statistical analysis

2.3.1.1 Analysis of the evolution of scientific output

The growth trend of publications reflects the dynamic development of scientific knowledge directly. Hence, it is necessary to analyze this trend and explore the causes. Figure 2.1 reveals that, despite a few fluctuations, there has been a gradual increase in the number of annual publications and citations from 1998 to 2021 in general. The first study in the Web of Science database that considered the use of ICTs in microfinance was published in 1998 and has only been cited 18 times so far. By examining the relationship between household conditions and MFIs lending technologies, this research suggested that MFIs lending

technologies should be redesigned to be sensitive to initial household conditions (Sinha & Matin, 1998).

It can be seen that there is a surge in the number of both publications and citations after 2006. There are two possible reasons for this phenomenon. On the one hand, in 2006, the Nobel Peace Prize was awarded to the founder of Grameen Bank——Muhammad Yunus, who contributes substantially to poverty alleviation through microfinance (Hermes & Hudon, 2018). Another possible explanation for this might be that the rapid development of technologies contributed to the development of financial innovation (Liu et al., 2020) and E-finance (Shahrokhi, 2008) after 2006. Accordingly, there has been a growing concern about microfinance and the application of ICTs over the past ten years. Subsequently, in 2017, the number of papers reached a peak level of 39. Compared with the only two publications in 1998, it indicates that this field attracts more and more academic attention.

Interestingly, publications leveled off but citations dropped sharply after 2015. This result may potentially suggest a relative decline in interest among academics. However, it is also likely to be related to the evolution of the topic and semantic change in the literature. For example, since microfinance is a tool to achieve financial inclusion, many researchers have recently turned to focus on financial inclusion instead of just microfinance (Ozili, 2018; Schuetz & Venkatesh, 2020; Senyo & Osabutey, 2020). In this paper, however, considering financial inclusion is a broader scope and not limited to microfinance (Zaby, 2019), it was excluded from our search string.

What stands out in this figure is that the number of citations attained two apparent peaks in 2012 and 2015, respectively. The reason for this condition is that some significant literature occurred in these years which were cited frequently. For example, the articles published by Lee in 2012 and Bruton in 2015 were cited as many as 134 and 235 times, respectively. Both of the two research studies the application of ICT-based platforms, including crowdfunding and peer-to-peer lending (Bruton et al., 2015; Lee & Lee, 2012).

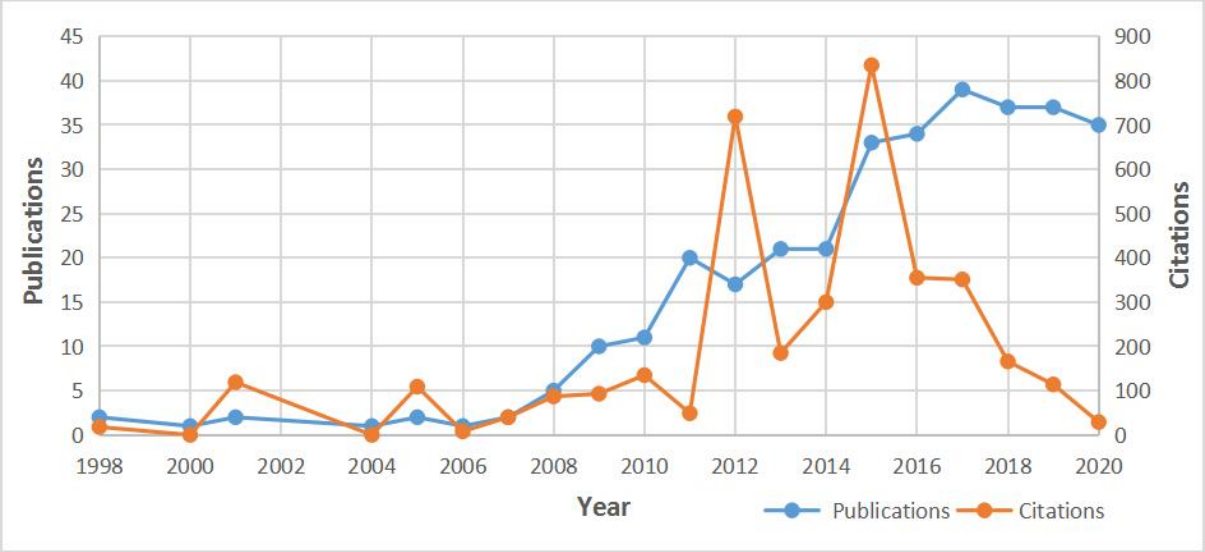

Figure 2.1 Trends of publications and citations

2.3.1.2 Analysis of the distribution of publications by institutions and countries

Table 2.2 provides the fruitful institutions that published more than two articles. Apart from some comprehensive universities (e.g., National University of Singapore, Tsinghua University and Washington State University), many of them are specialized institutions focusing on business and economics, such as Centre for European Research in Microfinance, Fundacao Getulio Vargas, HEC Montreal, Copenhagen Business School, Stockholm School of Economics, Burgundy School of Business, Group ESC Dijon Bourgogne. It is noteworthy that the National University of Singapore is the most prolific research institution with seven publications, then come Singapore Management University (6 publications) and North Dakota State University (5 publications). However, the institution receiving the most citations is Washington State University with a high level of 331 times; next are the University of Zaragoza (175 citations) and Texas A&M University (147 citations). This result can be explained by a few influential articles published by these two institutions. For instance, one article published by Washington State University in 2015 studied online crowding platforms (Allison et al., 2015) and singly attained as many as 200 citations. Moreover, two articles by Serrano-Cinca et al. from the University of Zaragoza received 75 and 72 citations, respectively. Both of them focused on the topic of P2P lending (Serrano-Cinca & Gutiérrez-Nieto, 2016; Serrano-Cinca et al., 2015). It can be referred that

ICT-based platforms are a major concern.

On the other hand, it can be observed that the most active country studying microfinance and ICTs use is the United States (6 institutions). Furthermore, China, France and Singapore each have two institutions. The result also shows us the geographical distribution of research. Among the top 20 institutions, Europe and North America each account for 35% (7 of 20). Besides, 25% (5 of 20) institutions are located in Asia and 5% (1 of 20) are in South America.

The last row lists the primary cooperative relationships between institutions based on co-authorship analysis. In view of the results, Tsinghua University cooperating with the National University of Singapore and the University of Michigan to study crowdfunding (Ai et al., 2016) has the most extensive partnership. Apart from that, the University Regensburg and Centre for European Research in Microfinance (CERMi), as well as Copenhagen Business School and Stockholm School of Economics, also conducted collaborative research on crowdfunding projects (Dorfleitner et al., 2020; Nielsen, 2018). Additionally, some institutions such as North Dakota State University and Northern Arizona University worked together to study P2P lending (Dorfleitner & Oswald, 2016; Riggins & Weber, 2015). Nevertheless, most institutions conducted independent research, such as the University of Technology Mara and the University of Zaragoza.

Table 2.2 The most prolific institutions (3 papers or above)

Num.	Institution	Country	Documents	Citations	Main Cooperative Institutions
1	National University of Singapore	Singapore	7	30	Tsinghua university University of Michigan
2	Singapore Management University	Singapore	6	49	North Dakota State University
3	North Dakota State University	USA	5	36	Singapore Management Univers Northern Arizona University
4	University of Michigan	USA	4	17	Tsinghua university National University of Singapor
5	University Regensburg	Germany	4	10	Centre for European Research in Microfinance
6	University of Technology Mara	Malaysia	4	4	\
7	University of Zaragoza	Spain	4	175	\
8	Tsinghua University	China	3	16	National University of Singapore University of Michigan University of Colorado

Num.	Institution	Country	Documents	Citations	Main Cooperative Institutions
					Boulder
9	Centre for European Research in Microfinance	Belgium	3	2	University Regensburg
10	Fundacao Getulio Vargas	Brazil	3	53	HEC Montreal
11	HEC Montreal	Canada	3	56	Fundacao Getulio Vargas
12	Northern Arizona University	USA	3	12	North Dakota State University
13	Copenhagen Business School	Denmark	3	10	Stockholm School of Economics
14	Stockholm School of Economics	Sweden	3	10	Copenhagen business school
15	Texas A&M University	USA	3	147	Washington State University
16	University of Colorado Boulder	USA	3	92	Tsinghua university
17	Washington State University	USA	3	331	Texas A&M University
18	Burgundy School of Business	France	3	9	\
19	Group ESC Dijon Bourgogne	France	3	1	\
20	Harbin Institute of Technology	China	3	7	\

Source: own elaboration

2.3.1.3 Analysis of journals

The statistics of the prolific journals publishing more than three articles are presented in Table 2.3. Notably, Electronic Commerce Research and Applications published the most articles (6), followed by Sustainability (5) and Journal of Business Ethics (5). What is interesting is that, from the perspective of citations received, Entrepreneurship Theory and Practice is the most influential journal with 563 citations and 140.75 citations per document; Development and Change is next with 112 citations and 56 citations per document.

Furthermore, the journal impact factor (JIF) provided by the Web of Science database is introduced in this table to evaluate the influence of journals. As a widespread measure, the result of JIF is obtained by dividing the number of citations received by a journal in a designated year for the contents in the previous years by the total number of articles and reviews published in the previous two years (Ali, 2021). It is somewhat surprising that few authoritative management information systems (MIS) journals were noted in Table 3 (only

Electronic Commerce Research and Applications). Instead, publications are scattered in other journals related to economics, management or development, such as Journal of Business Ethics, Journal of Product Innovation Management, Journal of Small Business Management, and World Development. This result suggests that research on ICTs in microfinance is insufficient and fragmented. Another possible explanation for this unexpected finding might be attributed to a lack of interest in microfinance in current MIS journals.

Apart from these journals, some influential books are needed to be reviewed, such as Ashta (2010), Vong and Song (2015). The former covering 18 documents in our samples demonstrates a series of advanced technologies for microfinance in detail, such as point of sale technology (Musa & Khan, 2011), mobile banking (Morawczynski, 2011; Shrivastava, 2011), Web 2.0 technologies (Ashta & Assadi, 2011), P2P microlending websites (Assadi & Hudson, 2011) and other online financing platforms, while the latter with four papers in our samples analyzes the application and effect of emerging technologies, especially mobile technologies in microfinance.

Table 2.3 The prolific journals (2 or above)

Num.	Journal	D	TC	TC/D	JIF	Country	Subject
1	Electronic Commerce Research and Applications	6	304	50.67	3.824	USA	Economics
2	Sustainability	5	20	4.00	2.576	Switzerland	Environment / Ecology
3	Journal of Business Ethics	5	5	1.00	4.141	Netherlands	Economics
4	Entrepreneurship Theory and Practice	4	563	140.75	10.750	USA	Economics
5	Venture Capital	4	39	9.75	1.844	England	Economics
6	Third World Quarterly	3	87	29.00	1.754	England	Environmental Studies Geography and Development
7	Information Technology for Development	3	28	9.33	2.733	England	Library and Information Sciences
8	Development and Change	2	112	56.00	2.246	England	Environmental Studies Geography and Development
9	Economic Modelling	2	46	23.00	1.93	Netherlands	Economics
10	World Development	2	41	20.50	3.869	England	Environmental Studies Geography and Development
11	Journal of Product Innovation Management	2	37	18.50	5.000	USA	Management
12	Developing Economies	2	36	18.00	0.840	Japan	Environmental Studies Geography and Development
13	Telecommunications Policy	2	30	15.00	2.224	England	Library and Information

Num.	Journal	D	TC	TC/D	JIF	Country	Subject
14	Journal of Small Business Management	2	20	10.00	3.461	USA	Sciences Management
15	Ids Bulletin-Institute of Development Studies	2	18	9.00	0.606	England	Environmental Studies Geography and Development
16	Post-Communist Economies	2	16	8.00	0.875	England	Economics

D: the number of documents; TC: the number of citations; TC/D: the number of citations by documents; JIF: journal impact factor

Source: own elaboration

2.3.1.4 Analysis of core authors

Table 2.4 provides the contributing authors from 1998 to 2021. There are 13 authors who have published more than two articles. Among these scholars, Riggins from North Dakota State University published the most papers (7), while Weber, Guan, Ashta, Gutierrez-Nieto, Assadi and Serrano-Cinca published four articles each. Besides, six authors, including Kauffman, Amin, Dorfleitner, Jayo, Li and Pozzebon, published three papers each. With respect to research direction, Riggins, Weber, Kauffman and Jayo focused on the impact and role of ICTs in microfinance (Diniz et al., 2014; Kauffman & Riggins, 2012; Riggins & Weber, 2016), while Serrano-Cinca, Ashta, Assadi, Amin, Li and Dorfleitner researched crowdfunding and P2P lending platforms (Amin & Li, 2014; Assadi et al., 2018; Serrano-Cinca & Gutiérrez-Nieto, 2016; Serrano-Cinca et al., 2015). Moreover, Guan and Ashta also followed an interest in mobile technologies and mobile banking (Ashta, 2017; Guan, 2015), whereas Pozzebon studied the use of ICTs to promote financial inclusion (Diniz et al., 2012).

As mentioned in the previous section, the extensive collaborations between these core authors can also be observed based on co-authorship analysis. For example, Riggins cooperated with Kauffman to study the role of ICTs in microfinance (Kauffman & Riggins, 2012). He also researched the information asymmetry of P2P lending platforms with Weber (Riggins & Weber, 2017). Furthermore, Amin and Li, as well as Gutierrez-Nieto and Serrano-Cinca, have also cooperated to study P2P lending platforms (Amin & Li, 2014; Serrano-Cinca & Gutiérrez-Nieto, 2016).

Table 2.4 Contributing authors (3 or above)

Num.	Author	Institution	Publications	Year Begin
1	Frederick J Riggins	North Dakota State University	7	2010

Num.	Author	Institution	Publications	Year Begin
2	David M Weber	Northern Arizona University	4	2013
3	Lim Siong Guan	National University of Singapore	4	2015
4	Arvind Ashta	Burgundy School of Business	4	2011
5	Begona Gutierrez-Nieto	University of Zaragoza	4	2008
6	Djamchid Assadi	Burgundy School of Business	4	2011
7	Carlos Serrano-Cinca	University of Zaragoza	4	2008
8	Robert J Kauffman	Singapore Management University	3	2010
9	Md Khaled Amin	American International University-Bangladesh	3	2014
10	Gregor Dorfleitner	University of Regensburg	3	2016
11	Martin Jayo	University of Sao Paulo	3	2008
12	Jinghua Li	Zhejiang Gongshang University	3	2014
13	Marlei Pozzebon	HEC Montreal	3	2008

Source: own elaboration

2.3.1.5 Analysis of influential documents

The influence of a publication can be reflected by the citations it received. Table 2.5 lists the top 20 most influential publications based on citations. The publication receiving the most citations (235) is Bruton et al. (2015), which analyzed the use of microfinance, crowdfunding and P2P lending in promoting entrepreneurship. The following article exploring the impact of social media on the sales of the microlending market (Stephen & Galak, 2012) received 211 citations. Another influential paper receiving 195 citations assessed the impact of the extrinsic and intrinsic cues in microloan entrepreneurial narratives on funding outcomes (Allison et al., 2015). It is worth noting that 4 of the top 5 documents focused on ICT-based platforms——crowdfunding and P2P lending (Allison et al., 2015; Bruton et al., 2015; Burtch et al., 2014; Lee & Lee, 2012). Interestingly, among these 20 documents, more than half (12) researched these issues. Besides, there are three papers on the application of mobile technologies (e.g., mobile phone, mobile banking, mobile payment and mobile money) (Bayes, 2001; Diniz et al., 2012; Duncombe & Boateng, 2009; Suri & Jack, 2016). This result further confirms that crowdfunding, P2P lending and mobile banking have been favorite topics for analysis in the field of microfinance. In addition to the above articles, the remaining four papers study women's empowerment (Holvoet, 2005), credit scoring (Yum et al., 2012), financial inclusion (Gabor & Brooks, 2017), as well as the debate regarding technologies for financial services (Bhatt

& Tang, 2001).

Additionally, the number of empirical studies (14) is more than twice that of conceptual studies (6). It indicates that scholars tend to use empirical methods to study this issue. Next, 90% (18 / 20) of the total number of documents are in the form of articles. More importantly, according to the classification of research directions offered by the Web of Science database, "business and economics" is the leading research field, followed by "computer science" and "Government and Law". It seems to be associated with the aim of microfinance——economic growth and poverty reduction (Newman et al., 2017). As a result, the subject receives more attention from the economic and business research field.

Table 2.5 The top 20 most cited documents （TR: types of the research; TD: types of documents; RD: research direction; Con: conceptual; Emp: empirical）

Num.	Documents	TR	TD	RD	Journals	Citation
1	Bruton et al. (2015). New financial alternatives in seeding entrepreneurship: Microfinance, crowdfunding, and peer-to-peer innovations	Con	Article	Business and Economics	Entrepreneurship Theory and Practice	235
2	Stephen and Galak (2012). The effects of traditional and social earned media on sales: A study of a microlending marketplace	Emp	Article	Business and Economics	Journal of Marketing Research	211
3	Allison et al. (2015). Crowdfunding in a prosocial microlending environment: Examining the role of intrinsic versus extrinsic cues	Emp	Article	Business and Economics	Entrepreneurship Theory and Practice	195
4	Lee and Lee (2012). Herding behavior in online P2P lending: An empirical investigation	Emp	Article	Business and Economics; Computer Science	Electronic Commerce Research and Applications	134
5	Burtch et al. (2014). Cultural differences and geography as determinants of online prosocial lending	Emp	Article	Computer Science; Information Science and Library Science; Business and Economics	MIS Quarterly	113
6	Suri and Jack (2016). The long-run poverty and gender impacts of mobile money	Emp	Article	Science and Technology	Science	110
7	Holvoet (2005). The impact of microfinance on decision-making agency: Evidence from South India	Emp	Article	Development Studies	Development and Change	108
8	Michels (2012). Do unverifiable disclosures matter? Evidence from peer-to-peer lending	Emp	Article	Business and Economics	Accounting Review	89
9	Short et al. (2017). Research on crowdfunding: reviewing the (very recent) past and celebrating the present	Con	Editorial Material	Business and Economics	Entrepreneurship Theory and Practice	85
10	Cordova et al. (2015). The determinants of crowdfunding success: Evidence from	Emp	Proceedings	Business and Economics; Social	\	81

Num.	Documents	TR	TD	RD	Journals	Citation
	technology projects		Paper	Sciences		
11	Yum et al. (2012). Mixture cure models in credit scoring: If and when borrowers default	Con	Article	European Journal of Operational Research	Business and Economics; Operations Research and Management Science	81
12	Serrano-Cinca and Gutiérrez-Nieto (2016). The use of profit scoring as an alternative to credit scoring systems in peer-to-peer (P2P) lending	Emp	Article	Science and Technology	Plos One	74
13	Gabor and Brooks (2017). The digital revolution in financial inclusion: International development in the fintech era	Emp	Article	Business and Economics; International Relations; Government and Law	New Political Economy	72
14	Serrano-Cinca et al. (2015). Determinants of default in P2P lending	Emp	Article	Computer Science; Operations Research and Management Science	Decision Support Systems	70
15	Bhatt and Tang (2001). Delivering microfinance in developing countries: Controversies and policy perspectives	Con	Article	Government and Law; Public Administration	Policy Studies Journal	64
16	Duncombe and Boateng (2009), Mobile phones and financial services in developing countries: A review of concepts, methods, issues, evidence and future research directions	Con	Article	Development studies	Third World Quarterly	63
17	Barasinska and Schafer (2014). Is crowdfunding different? Evidence on the relation between gender and funding success from a german peer-to-peer lending platform	Emp	Article	Business and Economics	German Economic Review	61
18	Bayes (2001). Infrastructure and rural development: insights from a Grameen bank village phone initiative in Bangladesh	Emp	Article, ProceedingsPaper	Agriculture; Business and Economics	Agricultural Economics	55
19	Beaulieu et al. (2015). A conceptual framework for understanding crowdfunding	Con	Editorial Material	Computer Science; Information Science and Library Science; Business and Economics	European Journal of Information Systems	51
20	Josefy et al. (2017). The Role of community in crowdfunding success: Evidence on cultural attributes in funding campaigns to “save the local theater”	Emp	Article	Business and Economics	Entrepreneurship Theory and Practice	48

Source: own elaboration

2.3.2 Co-citation analysis and co-word analysis

In this section, co-citation analysis and co-word analysis were performed to identify the research hotspots and emergent trends. Co-citation analysis varies according to the research object (e.g., articles, journals, authors), whereas co-word analysis is derived from “author

keywords". We performed these two analyses on cluster views, timezone views and timeline views provided by CiteSpace. In the process, the pivotal points and the dynamics of the research front were detected. Generally, the size of clusters depends on the number of co-cited references or keywords, while the size of the nodes indicates the frequency of an article or keyword co-cited. In addition, links connecting two nodes explain the relationship between the two co-cited articles or keywords. The thicker the link, the more frequently they are co-cited.

2.3.2.1 Co-citation analysis

CiteSpace provides us with an opportunity to perform cluster analysis of the co-citation network. Based on similarity or dissimilarity, clustering algorithms classify all of the cited references into several clusters (Frades & Matthiesen, 2010). In other words, articles within a cluster are more similar or consistent in content. Moreover, a series of statistics and views make it easier for us to detect the connections between clusters.

Figure 2.2 presents the four prominent clusters achieved based on co-cited references—Cluster #0 ("microfinance industry"), Cluster #1 ("emerging technologies"), Cluster #2 ("microfinance industry") and Cluster #5 ("sustainable growth"). These cluster labels are extracted from the titles of references through the Log-likelihood ratio (LLR) method. Although both Clusters #0 and Cluster #2 are labeled as "microfinance industry", their properties are not the same. Compared with Cluster #2, Cluster #0 mainly focuses on the study of online microfinance platforms, which will be analyzed in the following part.

It is worth noting that these clusters are closely connected due to the links of some key nodes. In essence, the publications corresponding to these nodes represent the close relationship between clusters. For example, Hermes et al. (2011) combing Cluster #1 and Cluster #2 argued that emerging banking technologies have helped MFIs to improve their sustainability and efficiency by reducing costs and improving the delivery of services. Similarly, Kauffman and Riggins (2012), which also combines Cluster #1 and Cluster #2, assessed the extent to which ICTs support the sustainability of microfinance.

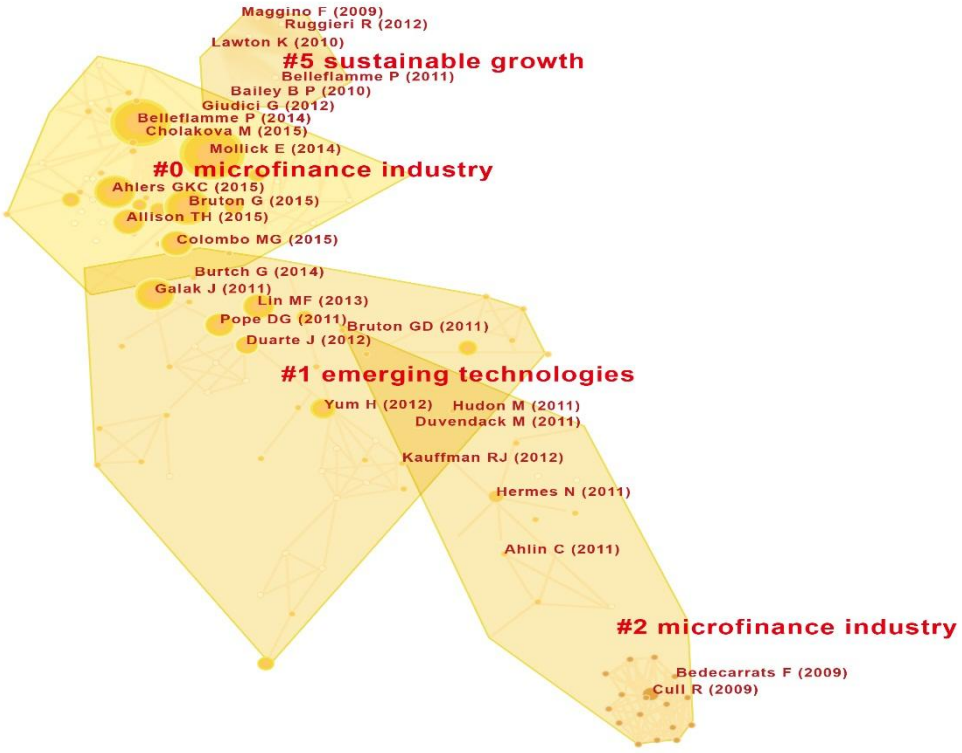

Figure 2.2 Clusters of co-cited references

Table 2.6 shows the basic information of these clusters, including the cluster ID, labels, size, silhouette, mean (year), and top terms (log-likelihood ratio, p-level). It is found that Cluster #0 labeled as "microfinance industry" has the most documents (84); Cluster #1 ("emerging technologies") is next with 45, while cluster #2 ("microfinance industry") and Cluster #5 ("sustainable growth") have 38 and 24, respectively. Furthermore, CiteSpace also offers the value of silhouette. Generally, it should be between 0 and 1. The closer the value is to 1, the more consistent or similar the content of the articles within the cluster. As can be seen from Table 2.6, the value of silhouette for all four clusters is greater than 0.92, which indicates the high quality of this cluster analysis. From the mean year, most papers in these clusters were published around 2011 except for those in Cluster #0 (2014).

To be specific, the studies of Cluster #0 pay attention to online microfinance platforms——crowdfunding (Ahlers et al., 2015; Allison et al., 2015; Belleflamme et al., 2015; Colombo et al., 2015; Mollick, 2014), while these studies in Cluster#2 focus on the impact of

microfinance (Duvendack et al., 2011), the nature of microfinance (Cull et al., 2009), performance or efficiency of MFIs (Ahlin et al., 2011; Hudon & Traca, 2011), outreach (Cull et al., 2011; Hermes et al., 2011). In addition, these papers in Cluster #1 research the adoption of ICT-based P2P lending and crowdfunding platforms, including their characteristics (Berkovich, 2011; Lee & Lee, 2012), profitability (Burtch et al., 2015; Emekter et al., 2015) and default probability (Dorfleitner et al., 2016) because of information asymmetries (Lin et al., 2013; Yum et al., 2012) and credit risk (Byanjankar et al., 2015). At last, Cluster #5 studies the rise and revolution of crowdfunding (Howe, 2006; Lawton & Marom, 2010).

Table 2.6 Details of main clusters

ID	Label	Size	Silhouette	Mean (Year)	Top Terms (log-likelihood ratio, p-level)
0	microfinance industry	84	0.926	2014	microfinance industry (17.81, 1.0E-4); emerging technologies (15.53, 1.0E-4); financial service (15.53, 1.0E-4); crowdfunding research (15.53, 1.0E-4); information sharing (13.26, 0.001)
1	emerging technologies	45	0.961	2011	emerging technologies (20.2, 1.0E-4); financial service (20.2, 1.0E-4); crowdfunding research (20.2, 1.0E-4); information sharing (17.25, 1.0E-4); empirical study (17.25, 1.0E-4)
2	microfinance industry	38	0.968	2011	microfinance industry (49.36, 1.0E-4); decomposition analysis (17.5, 1.0E-4); microfinance institution (17.5, 1.0E-4); communication technology (11.55, 0.001); intermediation market structure (11.55, 0.001)
5	sustainable growth	24	0.992	2011	sustainable growth (10.67, 0.005); useful way (10.67, 0.005); document model building (0.16, 1.0); qualitative system dynamics model (0.16, 1.0); underlying dynamics (0.15, 1.0)

Source: own elaboration from data provided by CiteSpace (2021)

Through analyzing the top 20 most co-cited references shown in Table 2.7, we can also identify the hot topics are online crowdfunding and P2P lending platforms. In fact, 80% (16 of 20) belong to this subject. This result is consistent with the previous citation analysis. Additionally, 11 papers are from cluster #0, 7 from Cluster #1 and 2 from Cluster #2. The most co-cited reference is Mollick (2014), which offered insights into how crowdfunding works; next is Belleflamme et al. (2015), which developed a model combining crowdfunding with pre-ordering and price discrimination.

Furthermore, the relationship between online microfinance platforms and entrepreneurship

aroused widespread attention from researchers. For instance, Bruton et al. (2015) investigated the influence of microfinance, crowdfunding and P2P lending in seeding entrepreneurship, while Ahlers et al. (2015) analyzed the signals used by entrepreneurs to encourage small investors to invest financial resources in an equity crowdfunding environment. Another example is Allison et al. (2015), which argued that crowdfunding platforms are a beneficial tool to promote entrepreneurial activity through microcredit and assessed how the extrinsic and intrinsic motivating cues in microloan entrepreneurial activities affect funding outcomes.

Table 2.7 Top 20 most co-cited documents

Num.	Author and Year	Titles of Documents	CC	Cluster ID
1	Mollick (2014)	The dynamics of crowdfunding: an exploratory study	44	0
2	Belleflamme et al. (2015)	Crowdfunding: Tapping the right crowd	36	0
3	Bruton et al. (2015)	New financial alternatives in seeding entrepreneurship: Microfinance, crowdfunding, and peer-to-peer innovations	32	0
4	Ahlers et al. (2015)	Signaling in equity crowdfunding	21	0
5	Allison et al. (2015)	Crowdfunding a prosocial microlending environment: Examining the role of intrinsic versus extrinsic cues	21	0
6	Lin et al. (2013)	Judging borrowers by the company they keep: Social networks and adverse selection in online peer-to-peer lending	21	1
7	Colombo et al. (2015)	Internal social capital and the attraction of early contributions in crowdfunding	19	0
8	Cholakova and Clarysse (2015)	Does the possibility to make equity investments in crowdfunding projects crowd out reward–based investments?	18	0
9	Galak et al. (2011)	Microfinance decision making: A field study of prosocial lending	18	1
10	Agrawal et al. (2011)	The geography of crowdfunding	17	0
11	Pope and Sydnor (2011)	What's in a picture? Evidence of discrimination from prosper.com	17	1
12	Yum et al. (2012)	From the wisdom of crowds to my own judgment in microfinance through online peer-to-peer lending platforms	15	1
13	Moss et al. (2015)	The effect of virtuous and entrepreneurial orientations on microfinance lending and repayment: A signaling theory perspective	14	0
14	Duarte et al. (2012)	Trust and credit: The role of appearance in peer-to-peer lending	13	1
15	Ordanini et al. (2011)	Crowd-funding: Transforming customers into investors through innovative service platforms	13	0
16	Kauffman and Riggins (2012)	Information and communication technology and the sustainability of microfinance	12	1
17	Burtch et al. (2014)	Cultural differences and geography as determinants of online prosocial lending	11	1
18	Donner and Tellez (2008)	Mobile banking and economic development: Linking adoption, impact, and use	11	2
19	Cull et al. (2009)	Microfinance meets the market	10	2
20	Zhang and Liu (2012)	Rational herding in microloan markets	10	0

CC: the number of co-citations

Source: own elaboration

2.3.2.2 Co-word analysis

Understanding and detecting the dynamics of a research field is essential for researchers. In this section, the timezone view and timeline view were presented through CiteSpace to perform the co-word analysis. Both of these diagrams incorporate the time factor into the visual analysis, which can help us to identify the hot topics and the evolution of the

research effectively. Before running the software, we merged synonyms by creating a file named “CiteSpace.alias” in the original data folder. It is necessary to merge them since some different keywords have the same meaning. For example, “micro finance”, “micro-finance” and “microcredit” were merged into “microfinance”. In addition, we integrated “ICT”, “information and communication technology”, “communication technology” and “telecommunications technology” into “technology” for ease of analysis.

Figure 2.3 provides the timezone view based on the keywords co-occurring over three times. The revolution of the keywords and their connection with each other can be recognized from it. Each node in the figure represents a keyword, and its location depends on the year in which it first appeared. The size of the node represents the co-occurrence frequency of this keyword from the year of appearance to the present. For instance, the largest node “microfinance” co-occurred 152 times with other keywords from 2009 to 2021. While the smallest node “blockchain” co-occurred only three times since it appears late (from 2020 to 2021).

In Figure 2.3, microfinance, crowdfunding, technology, performance, model, impact, innovation, information, financial inclusion, and entrepreneurship are the top 10 most frequently co-cited keywords to study this issue. Moreover, market, outreach, investment, banking, determinant, fintech, poverty, P2P lending, microfinance institution, Islamic microfinance, and efficiency are also widely used by researchers. Analysis from the perspective of time, fintech, network, blockchain, finance, access, entrepreneur, determinant, sustainability, and so on attracted attention by the latest research. These keywords mentioned above also represent hot topics and emerging trends. The details of these keywords are given in Table 8.

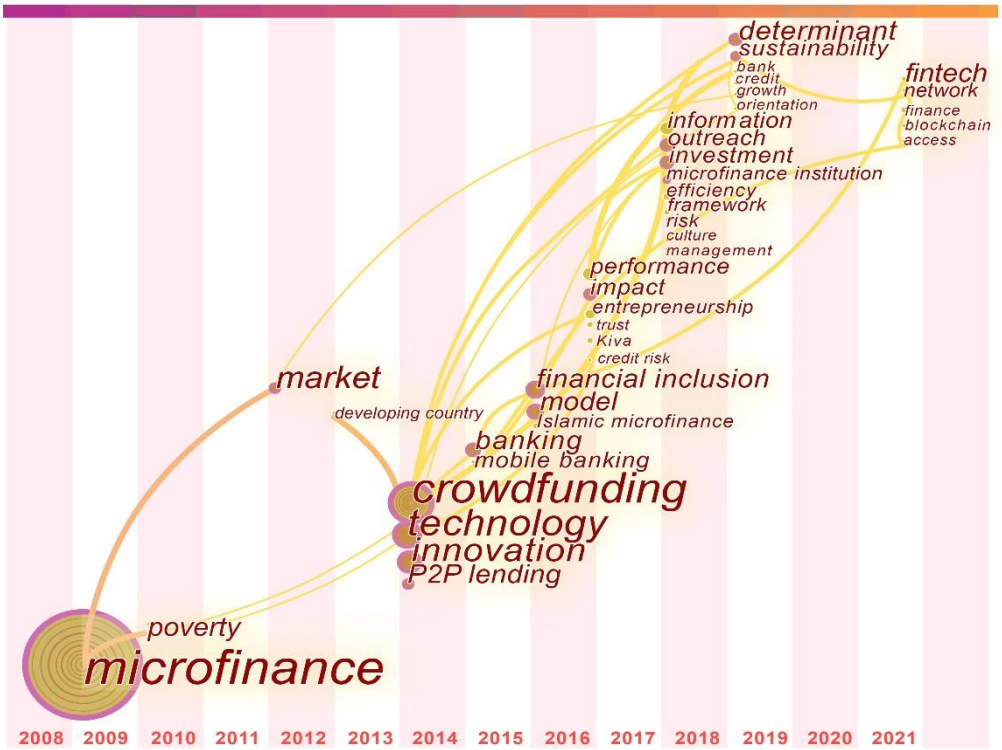

Figure 2.3 Timezone view based on keywords

Table 2.8 Main keywords by co-citations

Num.	Keywords	Co-citations	Year	Num.	Keywords	Co-citations	Year
1	microfinance	153	2009	21	efficiency	6	2018
2	crowdfunding	44	2014	22	framework	6	2018
3	technology	27	2013	23	mobile banking	6	2015
4	performance	25	2017	24	sustainability	6	2019
5	model	22	2016	25	network	5	2020
6	impact	21	2017	26	risk	4	2018
7	innovation	19	2014	27	credit risk	3	2017
8	information	16	2018	28	credit	3	2019
9	financial inclusion	16	2016	29	finance	3	2020
10	entrepreneurship	15	2017	30	developing country	3	2013
11	market	13	2012	31	Kiva	3	2017
12	outreach	12	2018	32	trust	3	2017
13	investment	11	2018	33	bank	3	2019
14	banking	10	2015	34	culture	3	2018
15	determinant	10	2019	35	blockchain	3	2020
16	fintech	8	2020	36	access	3	2020
17	poverty	8	2010	37	management	3	2018
18	P2P lending	8	2014	38	growth	3	2019

Num.	Keywords	Co-citations	Year	Num.	Keywords	Co-citations	Year
19	microfinance institution	8	2018	39	orientation	3	2019
20	Islamic microfinance	7	2016				

Source: own elaboration from data provided by CiteSpace (2021)

Unlike timezone views, timeline views are presented in the form of clusters. As shown in Figure 2.4, the timeline view generated in this paper consists of 5 clusters, including Cluster #0 (“knowledge sharing”), Cluster #1 (“social crowdfunding platform”), Cluster #2 (“financial inclusion”), Cluster #3 (“P2P lending”), Cluster #4 (“fintech research”), Cluster #5 (“human capital”). The timespan of each cluster is marked as yellow lines. Table 2.9 provides the basic information of these clusters.

Among these clusters, Cluster #0 (“knowledge sharing”) has the most keywords——microfinance, technology, credit, developing country, innovation, determinant, Kiva, framework, risk, as well as the most extended timespan (from 2009 to 2020). While Cluster # 3, with the keywords credit risk, trust, organization, model, culture, and management, has the shortest timespan (from 2016 to 2018). Other clusters with a relatively long timespan are Cluster #2 (from 2010 to 2020), including banking, poverty, finance, fintech, impact, financial inclusion, mobile banking, and Cluster #1 (from 2013 to 2019) with investment, growth, crowdfunding, information, crowdsourcing, entrepreneurship, market, and crowd. In addition, we can also recognize the two latest clusters——Cluster #4 (from 2017 to 2020) and Cluster #5 (from 2016 to 2020). Cluster #4 contains keywords like microfinance institutions, performance, outreach, bank, efficiency, blockchain, and Cluster #5 involves orientation, network, sustainability, and Islamic microfinance.

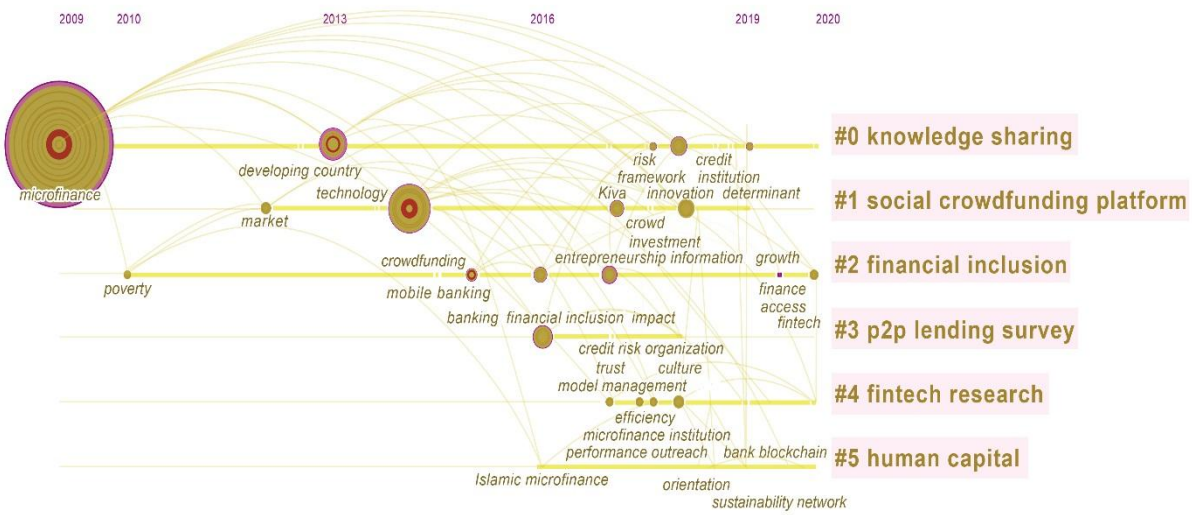

Figure 2.4 Timeline view based on keywords

Table 2.9 Details of keywords clusters

Cluster ID	Cluster Label	Size	Keywords	Timespan
0	knowledge sharing	10	microfinance, technology, credit, developing country, innovation, determinant, Kiva, framework, risk,	2009-2020
1	social crowdfunding platform	8	investment, growth, crowdfunding, information, crowdsourcing, entrepreneurship, market, crowd.	2013-2019
2	financial inclusion	8	banking, poverty, finance, fintech, impact, financial inclusion, mobile banking	2010-2020
3	P2P lending survey	6	credit risk, trust, organization, model, culture, management	2016-2018
4	fintech research	6	microfinance institutions, performance, outreach, bank, efficiency, blockchain	2017-2020
5	human capital	4	orientation, network, sustainability, Islamic microfinance	2016-2020

Source: own elaboration from data provided by CiteSpace (2021)

To further illustrate the impact of ICTs on the microfinance industry in detail, we present Figure 2.5. It can be seen from this figure, that “technology” in Cluster #0 is associated with almost all clusters except Cluster #1 and Cluster #3. Specifically, the keyword “technology” is linked with “microfinance”, “Islamic microfinance”, “microfinance institutions”, “developing country”, “blockchain”, “fintech”, “Kiva”, “framework”, “determinant”, “innovation” and the like keywords. Research corresponding to these connections, on the one hand, evaluated the impact of ICTs on various aspects of microfinance. For example, Diniz et al. (2014) found that ICT-based platforms can help expand the microfinance business through the cooperation between commercial banks and

local MFIs. According to Singh and Padhi (2015), ICTs use can promote efficiency in terms of cost and client management. Furthermore, Riggins and Weber (2016) found that ICTs can affect intermediation and market structure among different participants in the microfinance industry by referring to industry risk reports from 2011 to 2014. Besides, Akhter (2018) found that ICTs have an insignificant relationship with the performance of microfinance institutions in Bangladesh. In contrast, the latest study carried out by Ali et al. (2021) revealed that investments in ICTs were positively related to MFIs' financial performance.

Apart from that, numerous studies analyzed the impact of mobile technologies (or mobile phones, mobile banking, mobile money, mobile payment) on microfinance. For example, Amran et al. (2014), Assadi et al. (2018) and Gomera (2020) reported that the application of mobile technologies can improve financial services. Both Vong and Song (2015) and Uwamariya et al. (2020) focused on the impact of mobile technologies on the performance of MFIs. In comparison, Elliot et al. (2018) found that mobile technologies play a role in mitigating microfinance market inefficiencies.

On the other hand, previous studies also examined the factors influencing the adoption of ICTs in the microfinance industry. For instance, based on the technology acceptance model (TAM), Wibowo et al. (2020) found that maqashid sharia （an individual's perceptions based on his/her religious understanding） and market structure directly influenced the intention to use technologies in Islamic microfinance. Another investigation conducted by Tadele et al. (2018) claimed that the size of MFIs, financial structure, and social-oriented funding are positively related to MFI website accessibility. Besides, Rozzani et al. (2016) found that the lack of easiness in methods of conducting transactions affected the interest of clients in using mobile banking.

What is more, the co-occurrence of technology with Kiva, fintech and blockchain explains the evolution of technology research. As an online crowdfunding platform, Kiva has received a great deal of recent academic attention. In fact, many studies obtained data from Kiva (Burtch et al., 2014; Ly & Mason, 2012; Meer & Rigbi, 2013) or introduced Kiva into their case studies (Chen et al., 2017; Ge et al., 2016; Uddin et al., 2018) to research

crowdfunding and P2P lending. As for fintech, which is defined as technological innovations in financial services (Vučinić, 2020), many investigations have combined it with financial inclusion. For example, Demir et al. (2020), Bhagat and Roderick (2020), and Mushtaq and Bruneau (2019) all argued that fintech plays a vital role in financial inclusion. Nevertheless, according to Vučinić (2020), fintech also brings micro-financial and macro-financial risks to the financial system. Blockchain research primarily concentrates on adopting blockchain technology (Hu et al., 2018; Mukkamala et al., 2018) and its impact (Ozili, 2020; Seyedsayamdost & Vanderwal, 2020). For instance, Lane et al. (2017) discussed the importance of blockchain in lowering financial inclusion barriers. To sum up, applying fintech, especially blockchain and other emerging technologies, to promote financial inclusion is one of the research trends in terms of ICTs use in microfinance.

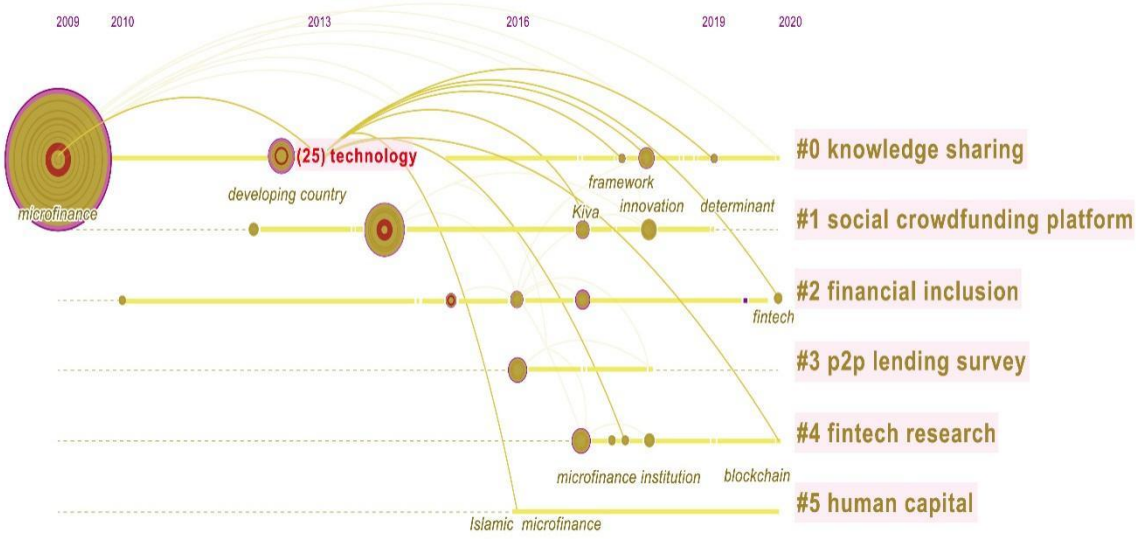

Figure 2.5 Links to "technology"

2.4 Discussion and conclusions

2.4.1 Discussions

Despite the significance of ICTs in the development of the microfinance industry, few studies have provided a whole picture of the relationship between microfinance and ICTs.

This paper aims to examine the role of ICTs in microfinance by systematically reviewing the literature with bibliometric methods. Although this method has been introduced to the microfinance field recently, this paper is the first to address issues from the perspective of ICTs.

In this study, a total of 347 samples were collected from the Web of Science database with reference to the guideline of the systematic review. To carry out the bibliometric analysis, the methods used in this paper include descriptive statistical analysis, co-citation analysis, and co-word analysis. In the co-citation analysis section, we performed these two analyses on cluster views, timezone views, and timeline views provided by CiteSpace. In this process, the pivotal points and the dynamics of the research front were detected.

Based on descriptive statistical analysis, the evolution of scientific output, the active institutions and countries, the influential journals, authors and publications were identified. First, it is found that there has been an overall increase in the number of annual publications and citations from 1998 to 2021. After 2006, a surge occurred in the number of both publications and citations. One possible reason for this is that the Nobel Peace Prize was awarded to the founder of Grameen Bank--Muhammad Yunus in 2006. This result may be also associated with the rapid development of technologies after 2006. Second, we found that the National University of Singapore, Singapore Management University and North Dakota State University are the top 3 prolific research institutions, while Tsinghua University has the most extensive partnership. From the distribution of these institutions, the most active countries are the United States, followed by China, France, and Singapore. Third, Electronic Commerce Research and Applications, Sustainability and Journal of Business Ethics are recognized as the top 3 productive journals. We also identified “business and economics” as the leading research field, followed by “computer science” and “Government and Law”. Additionally, the most influential publications, such as Bruton et al. (2015), Stephen and Galak (2012) and Allison et al. (2015), are pointed out by citations. Finally, it turns out that there are 13 authors who have published more than two articles. Riggins, Weber, Guan, Ashta, Gutierrez-Nieto, etc. contribute substantially to this research field.

A key finding is that ICT-based crowdfunding and P2P lending platforms have been the major topics of this research field. In addition, there has been a spate of research interest in the role of these online microfinance platforms in entrepreneurship. The following fact can explain this result. At first, according to the number of citations, 12 of the top 20 documents focused on these issues. Besides, institutions with extensive partnerships, such as Tsinghua University, the National University of Singapore and the University of Michigan, also mainly researched online microfinance platforms. Apart from that, the results of the co-citation analysis further confirm this conclusion. In the co-citation analysis section, we found that, among the top 20 most co-cited references, 80% of them studied online crowdfunding and P2P lending platforms. Also, based on cluster analysis, both Cluster #0 and Cluster #1 pay attention to this subject. In the section of the co-word analysis, the keyword "crowdfunding" ranks second after "microfinance" with as many as 44 co-citations. Another research hotspot is mobile banking or mobile payments according to the result of citations analysis and co-citation analysis.

To further illustrate the impact of ICTs on the microfinance industry, we have analyzed the links between "technology" and "microfinance" shown in the timeline view. Research corresponding to these connections, on the one hand, examined the impact of ICTs on various aspects of microfinance, including impacts on operations, efficiency, performance, sustainability, outreach, etc. In particular, numerous studies evaluated the impact of mobile technologies (or mobile banking, mobile payment, mobile money) on microfinance. On the other hand, some of these works explored the factors influencing the adoption of ICTs in microfinance.

Based on the above findings, it can be inferred that studies on microfinance and ICTs use can be divided into two categories. First, from the macro-level, many studies explored the relationship between ICTs and the microfinance industry directly. A classic example is Kauffman and Riggins (2012), which discussed the role and impact of technology on the sustainability of the microfinance industry. Another category is analyzing the specific application of ICTs in the microfinance industry——ICT-based crowdfunding and P2P lending platforms, including how they work, their revolution and risks, their relationship

with entrepreneurship, etc. It is expected that ICTs and ICT-based platforms will continue to play a role in the future development of microfinance and even the entire finance industry. Subsequently, more and more academic attention will be put on this subject.

At last, we proposed that research on applying fintech, especially blockchain technology and other emerging technologies, to promote financial inclusion is one of the future research trends. Although there is a growing body of literature on the application of emerging fintech, limited empirical evidence could be found to measure its impact. Future work could be done to examine whether, how and to what extent the operation of MFPs might be affected by these technology innovations with empirical methods (Cai, 2018). Accessing how managers or investors respond to these changes will also be interesting. Otherwise, considering the potential risks appearing with the advent of emerging technologies, future research regarding risk management will also be worthwhile. More broadly, other interesting questions such as the opportunities and challenges faced by COVID-19, the role of fintech in Islamic countries, factors influencing the customer experience of using fintech and digital solutions from the microfinance sector and if these digital solutions can have positive or disruptive influence on financial inclusion are raised by the study.

In addition, it can be anticipated that the evolution of these studies in keywords has similarities with research on entrepreneurship. During the past decade, literature on entrepreneurship has also focused on topics like microfinance (Karlan & Valdivia, 2011; Nega & Schneider, 2014), poverty (Bruton et al., 2013; Ogundele et al., 2012), developing countries (Munemo, 2012; Ratten, 2014), innovation (Huggins & Thompson, 2015; Ndubisi & Iftikhar, 2012), performance (Arogyaswamy, 2017; Randøy et al., 2015), credit risk (Shahriar & Garg, 2017), determinants (Khattab et al., 2017), microfinance institutions (Kittilaksanawong & Zhao, 2018), fintech (Kouame & Kedir, 2020). Furthermore, much of the recent literature pays particular attention to financial inclusion and entrepreneurship domains (Nogueira et al., 2020). According to Goel and Madan (2019) and Ajide (2020), financial inclusion has a significant effect on entrepreneurship. Given that the role of financial inclusion in poverty alleviation and economic development has been worldwide

recognized, more empirical research is needed to determine whether and how financial inclusion influences entrepreneurship. Besides, exploring more channels to realize the positive impact of financial inclusion on entrepreneurship will be interesting.

2.4.2 Limitations

Given that our samples come from a single database, future research can expand it to multiple databases for comparison and completeness. Another limitation of this study is that our sample size is restricted to search keywords. Some critical articles may have been missed because of ignoring certain keywords （e.g., financial inclusion）. Accordingly, future research can increase the sample size by adding additional keywords to generalize the findings. Notwithstanding these limitations, we hope the current study can provide a basis for future research.

2.4.3 Lessons learned

Information and communication technologies (ICTs) play a significant role in achieving the great potential of microfinance, especially in the context of the Covid-19 pandemic. Although considerable research effort has been put into microfinance and ICTs, no study has provided a whole picture of the relationship between microfinance and ICTs. This research aims to assess the role of ICTs in the microfinance industry by systematically reviewing the literature with bibliometric methods. It provides a comprehensive review of ICT-related research in the field of microfinance, which will be of interest to scholars, practitioners, policymakers, and evaluators, and has far-reaching theoretical and practical implications.

The study provides policymakers and evaluators with important insights into the role of ICTs in microfinance and even the entire financial industries. First, the role of technological advancements in the profitability, efficiency and sustainability of MFIs cannot be underestimated. Evaluators must conduct targeted investigations and determine whether and to what extent such technological improvements contribute to organizations. Second, policymakers and evaluators must evaluate the issues presented in this research, such as what has occurred and what might be done in the future to avoid technological maladies

and boost sustainable development. In addition to analyzing each cluster, the connection of distinct themes should also be taken into consideration by policymakers and evaluators. For example, the adoption of fintech to promote financial inclusion has become one of the future trends. Correspondingly, the implications of this trend for management processes and operations also require further evaluation. Third, our findings suggest that practical assessments of the cultural, organizational, and environmental elements that influence ICTs adoption are required. It is also necessary to evaluate the application of ICTs to management processes from a legal and ethical perspective.

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Chapter 3. How technology paradoxes and self-efficacy affect the resistance of facial recognition technology in online microfinance platforms: Evidence from China[2]

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Chapter 3. How technology paradoxes and self-efficacy affect the resistance of facial recognition technology in online microfinance platforms: Evidence from China

Abstract

This study aims to figure out the antecedents of users' resistance behavior toward facial recognition technology (FRT) in the microfinance platforms of China. We proposed a theoretical model by combining the technology paradox framework and self-efficacy theory. There were 418 valid questionnaires collected via an online survey. This study demonstrates, using structural equation modeling (SEM), that self-efficacy significantly affects technology paradoxes, anxiety, and resistance. Moreover, it suggests that the relationship between technology paradoxes and anxiety varies, and users are more concerned about the dissatisfiers of technology paradoxes (inefficiency and public). Besides, a positive correlation was found between anxiety and resistance. Finally, the results of the mediating effects test show that self-efficacy can not only directly affect resistance, but also indirectly influence it through efficiency, public, and anxiety. This study provides a deeper insight into users' resistance behaviors toward FRT and has significant implications for managers, technology designers, and future researchers.

Keywords: facial recognition technology (FRT), microfinance, technology paradoxes, self-efficacy, anxiety, resistance.

3.1 Introduction

During the past decade, artificial intelligence (AI) has revolutionized society with the advancement of a range of novel technologies, such as big data, machine learning, and deep learning. It utilizes computers to perform human-intelligence activities by acquiring knowledge, analyzing and studying the expression methods of knowledge (Da Xu et al., 2021; Zhang & Lu, 2021). In recent years, AI has emerged as a powerful and indispensable instrument for social development, especially with the spread of COVID-19 around the world.

As a critical element of AI technologies, facial recognition technology (FRT) has seen remarkable developments in the past few years. Currently, FRT plays an ever-increasing role, and new applications for FRT emerge in response to COVID-19. In China, for example, FRT was used to measure body temperature and track the activity history of infected patients during the epidemic (Ashta & Herrmann, 2021; Shamman et al., 2021). It is one of the pivotal biometric methods (e.g., voice, fingerprint, iris, face) and works by matching users' facial figures with existing images stored in the database. Compared with passwords or PINs, FRT is more accurate and secure since facial features cannot be stolen, forgotten, or guessed (Sukhija et al., 2016). Also, since there is no physical contact or interaction, it can be easier to use than other methods of identification and authentication (Elloumi et al., 2021). This is especially helpful in light of the current pandemic.

China has been at the global forefront of developing and applying FRT (Kostka et al., 2021). Compared with many other countries testing the technology itself instead of its application, China has established the FRT system and made it widely available for commercial use (Elloumi et al., 2021; Zhong et al., 2021). As early as 2017, China's e-commerce giant Alibaba first deployed FRT to a KFC restaurant for payment. Currently, FRT has been widely used for security systems, access control, and video surveillance in various places (Coşkun et al., 2017), such as stores, hospitals, schools, airports, hotels, restaurants, government agencies, and even social networks (Heyer et al., 2018; Lai & Patrick Rau, 2021). According to a report by Gen Market Insights, China is expected to reach 44.59% of the global market share in 2023 and become the largest consumption area

of FRT devices (Gravett, 2020).

FRT is also finding its way into the finance sector as a robust identification and authentication method. For example, banks have introduced it into the identification process in ATMs to improve security. Besides, with the rapid increase in mobile devices, mobile payment has become ubiquitous in China (Chen et al., 2019). Financial institutions have attempted to introduce FRT to support their mobile payment transactions to deliver more secure and convenient services. Indeed, face recognition payment (FRP) has been appreciated by users for its convenience.

The emergence and development of online microfinance platforms in China also provides opportunities for FRT usage. Generally, these platforms based on information and communication technology (ICT) tools (e.g., computers, the internet, websites, mobile devices) deliver financial services and provide both group and individual lending. (Moro-Visconti, 2021). They are gradually replacing traditional credit and are even inseparable from the daily consumption of the Chinese. For example, Ant Credit Pay, a microfinance service initiated by Alibaba, is widely used by Chinese consumers for early consumption and online shopping (Shi, 2020). Another example is Ali Finance, established in 2011 and provides loans to customers trading on the Alibaba and Taobao platforms (Ali, 2020; Tu et al., 2018). They have been updating their functions and applications, including incorporating FRT into the platforms (Liu, 2015; Zhong & Nieminen, 2015). For example, it uses FRT to extract and recognize the borrowers' facial features to assess their credibility and predict repayment performance (Chen & Xu, 2019). In fact, FRT has been used by most microfinance platforms in China to support their online transactions.

However, like many emerging technologies, FRT has turned out to be a controversial technology and is faced with challenges. Although security, accuracy, and convenience have been emphasized, there has been an increase in discussions about its disadvantages. Of particular concern are privacy issues (Brinckerhoff, 2018; Hirose, 2016; Mazura et al., 2012; NNG de Andrade et al., 2013; Wilkinson, 2020). As pointed out by Brinckerhoff (2018), FRT introduces privacy risks by collecting and storing customers' biometric data. In fact, the Chinese public hesitates to use FRT or even opposes it. According to a survey in

2019, 75% of over 6000 Chinese citizens preferred traditional recognition methods rather than FRT (Kostka et al., 2021). Similarly, the latest investigation in 2021 revealed that 87% of over 1500 respondents opposed FRP use. Nevertheless, some studies have suggested that Chinese users care more about convenience than privacy. For instance, Che et al. (2021) found that the rapid adoption of FRT in China is related to Chinese people's low level of concern for privacy protection through a comparative analysis. That means Chinese resistance to FRT may not only be attributed to their privacy concerns. Apart from further verifying whether privacy-related factors are relevant, it is necessary to take other factors into consideration, such as functional factors (like efficiency) and psychological factors (like self-efficacy).

Chae and Yeum (2010) highlighted that technology contains conflicts since it simultaneously has bright and dark sides. While customers can benefit from technologies, they may also have opposite experiences (Johnson et al., 2008). These paradoxical experiences then induce conflicts and negative feelings, such as anxiety and stress, which prevent customers from using technologies. In terms of FRT, individuals may perceive that it interferes with their daily lives instead of saving them time or increasing their security (Brown et al., 2021). Even if it is convenient and can help them save time, it can be time-consuming due to specific factors like lightning and camera characteristics. Another example is that users still take the risks of leaking personal information despite being protected by the platform's privacy policies. Even though customers often experience these conflicts when using FRT, researchers have often ignored its paradoxes.

To fill this gap, the current study employed the technology paradox framework (Jarvenpaa & Lang, 2005; Mick & Fournier, 1998) and expanded it by introducing self-efficacy theory. Thus, this research aims to appraise the degree to which technology paradoxes (efficiency/inefficiency and private/public) and self-efficacy influence users' anxiety and resistance toward FRT. The findings reported here contribute to the microfinance literature on ICT tools' usage. This study provides managers, technology designers, and future researchers with deeper insight into the users' resistance behavior toward FRT usage.

3.2 Literature review

3.2.1 Facial recognition technology and innovation resistance

3.2.1.1 Facial recognition technology

FRT is a technology that compares and identifies individual facial features (Kostka et al., 2021; Unar et al., 2014) and is widely used for identification and authentication in various industries (Ciftci et al., 2021; Leong et al., 2020b). As one of the most commonly used biometrics, it has been the subject of a lot of research and has been used in a wide range of fields, including healthcare (Jeon et al., 2019; Zuo et al., 2019), retail (Elloumi et al., 2021; Moriuchi, 2021), restaurants, hospitality and travel (Ciftci et al., 2021; Morosan, 2019, 2020; Xu et al., 2021), criminal identification (Purshouse & Campbell, 2019), as well as banking and finance (Normalini & Ramayah, 2013; Piotrowska et al., 2017).

In the banking and finance industry, Feng et al. (2017) pointed out that FRP, identification, and withdrawals are three primary applications of FRT. Being a robust authentication method, FRT is anticipated to promote the development of mobile finance (Caldwell, 2012). It provides customers with convenience and reduces costs to a large extent (Piotrowska et al., 2017; Zheng et al., 2019). Early studies have examined various variables that influence the customers' intentions to adopt FRT in the finance text. For example, Gatali et al. (2016) suggested that it was privacy concerns, education, and laws that restricted the Canadian banking industry from adopting biometrics, not technological issues. Agidi (2018) argued that security and efficiency are the keys to getting banks all over the world to use biometrics.

It is worth noting that abundant empirical research has been undertaken on FRP. These studies focused predominantly on exploring the factors influencing user experience and usage intention. Compared with traditional payment methods, FRP could trigger more privacy concerns as it can identify and monitor users without their permission (Erkin et al., 2009). Furthermore, users' acceptance of FRT has also been reported to be influenced by privacy-related variables, including perceived privacy risk, privacy concerns, and privacy control (Ioannou et al., 2020; Li et al., 2020; Liu et al., 2021). Although there are privacy risks in using FRP, users could also enjoy the convenience, security, and other benefits it

brings (Prabhakar et al., 2003). Accordingly, some previous researchers focused on the performance of FRP systems and analyzed factors such as security, ease of use, and usefulness. For instance, Zhang and Kang (2019) discovered that security, safety, expected effort, and visibility were antecedents of behavioral intentions. Both Dong and Hai (2019) and Zhong et al. (2021) suggested that perceived usefulness and perceived ease of use were major drivers of usage intentions utilizing the technology acceptance model (TAM) proposed by Davis (1989). In addition, psychological factors such as self-efficacy have also been found to influence users' behavioral intentions toward FRP. For instance, Moriuchi (2021) discovered that self-efficacy had moderating effects on perceived risk, performance expectation, and usage intention by combining the unified theory of acceptance and use of technology (UTAUT) and the theory of mind (ToM). Therefore, it is necessary to integrate privacy-related factors, functional factors, and psychological factors to examine users' acceptance of FRT.

While there has been increasing awareness of the importance of exploring the customers' intention to use FRT in the finance industry, little attention has been given to FRT usage in the microfinance field. During the past decade, microfinance has received much limelight in academia, and considerable research effort has concentrated on topics like its impact, sustainability, efficiency, outreach, financial inclusion, and entrepreneurship (Field et al., 2013; Gutiérrez-Nieto & Serrano-Cinca, 2019; Hermes & Lensink, 2011; Mushtaq & Bruneau, 2019). In addition, the role of ICT in microfinance has also been examined by previous studies (Kauffman & Riggins, 2012; Riggins & Weber, 2016; Singh & Padhi, 2015). For instance, Kauffman and Riggins (2012) argued that ICT is a potential solution for microfinance to face the harsh environment and survive. According to Ashta and Herrmann (2021), credit scoring based on AI technologies helps microfinance institutions (MFIs) to understand their customers better and lower risks. However, few investigations into FRT applications can be found in these studies.

3.2.1.2 Innovation resistance

Innovation resistance is a negative response to changes brought about by innovation (Ram, 1987). As with acceptance and adoption, innovation resistance is an essential element of

consumer behaviors (Seth et al., 2020). Understanding consumer resistance, according to academics and experts, is the key to ensuring that new technologies are accepted and utilised (Talwar et al., 2020).

Typically, most research on technical innovation focuses on "usage intention" or "continuance intention". These studies biasedly assumed that people are eager to adopt and employ new technologies and products (Talke & Heidenreich, 2014). However, the negative outcomes that people are reluctant to change are often ignored. Therefore, for the controversial FRT technology, it is necessary to investigate the antecedents of users' resistance to it.

Up to date, various consumer resistance models have been established to explore the major factors influencing users' resistance to new technologies (Abbas et al., 2017; Hew et al., 2019; Kaur et al., 2020; Kleijnen et al., 2009; Leong et al., 2020a; Liu et al., 2021; Mani & Chouk, 2017; Matsuo et al., 2018; Tang & Chen, 2022). For instance, Kleijnen et al. (2009) proposed a consumer resistance model and attributed the resistance to conflicts and the degree of change needed. Mani and Chouk (2017) analyzed the factors that affected users' resistance to smart products from the perspectives of products and consumers. Lee (2020) proposed that users' resistance to home Internet of Things (IoT) services was assosiated with vulnerability factors and privacy concerns.

However, there are a handful of studies exploring the fundamental mechanism of resistance to FRT. Gao et al. (2021) found that customers were less likely to use FRP despite requiring less effort and time because of the social presence effect. Liu et al. (2021) found significant relationships between perceived effectiveness of privacy policy, privacy concerns, perceived privacy risk, and users' resistance to FRP. Table 3.1 summarizes the literature exploring the usage intention of using FRP.

Table 3.1 Existing literature on exploring the acceptance of FRP

Article	Country	Theoretical Basis	Findings of the study
Dong and Hai (2019)	China	UTAUT and TAM	First, perceived ease of use, perceived risk, perceived usefulness are major drivers of usage intention. Second, subject norm, system quality, and perceive enjoyment indirectly affect usage intention.
Zhang and Kang (2019	China	_	First, security, social image, safety, expected effort, visibility

Article	Country	Theoretical Basis	Findings of the study
			influence usage intention. Second, perceived usefulness plays a mediating role. Third, openness characteristic moderates the effects of expected effort and security on usage intention.
Li et al. (2020)	China	Privacy calculus theory	First, threat appraisals and coping appraisals significantly influence usage intention. Second, the benefit-risk analysis shapes behaviorial intentions. Third, personal innovativeness is recognized as a moderator.
Zhong et al. (2021)	China	TAM	Factors such as perceived enjoyment, users' attitudes, personal innovativeness, and facilitating conditions are major determinants of usage intention.
Liu et al. (2021)	China	Innovation resistance theory, Privacy calculus theory	Perceived benefits, privacy concerns, perceived effectiveness of privacy, and perceived privacy risk influence users' resistance to FRP.
Hu et al. (2021)	China	_	First, perceived value, perceived value and trust significantly influence behavioral intentions toward FRP. Second, the correlation between usage intention and perceived value is moderated by information sensitivity.
Zhang et al. (2021)	China	_	First, the features of the FRP system, such as security, reliability convenience, and non-contact influence user innovation resistance. Second, user innovation resistance negatively affects usage intention.
Moriuchi (2021)	America	ToM and UTAUT	First, customers prefer to use FRP in stores than online. Second, trust and attitude have mediating effects on usage intention. Third, self-efficacy has moderating effects between performance expectation, perceived risk, and usage intention.

Notes: TAM - technology acceptance model; ToM - theory of mind; UTAUT - unified theory of acceptance and use of technology.

3.2.2 Technology paradoxes

Handy (1994) explained that a paradox is the simultaneous presence of opposing claims or assumptions. Consumers' experiences with novel technologies are often paradoxical (Johnson et al., 2008), and FRT is no exception. That means, while technology is performing its functions, it also brings about opposite results or situations (Chae & Yeum, 2010). These contradictory qualities of technologies can provoke consumers' conflicting perceptions (positive or negative attitudes) (Park & Zhang, 2021). By analyzing consumers' experiences of using household technologies, Mick and Fournier (1998) proposed the technology paradox framework, including paradoxes as follows: control/chaos, freedom/enslavement, new/obsolete, competence/incompetence, efficiency/inefficiency, fulfills/creates needs, assimilation/isolation, and engaging/disengaging. According to this framework, technology paradoxes could provoke the sentiments of conflict, anxiety, and stress. Besides, in the context of mobile technologies, Jarvenpaa and Lang (2005) added two more paradoxes—planning/improvisation and public/private. Recent authors have

further put forward the categorization of technology paradoxes. For example, Wilson-Nash and Tinson (2021) identified six paradoxes in the use of digital technology by the elderly, including an original paradox—attachment/non-attachment. They divided these paradoxes into functional, social, and psychological paradoxes.

Early studies have applied technology paradoxes to a variety of contexts. For example, both Johnson et al. (2008) and Bulmer et al. (2018) investigated the technology paradoxes experienced by those consumers of self-service technology. The former found paradoxes in this setting included freedom/enslavement, fulfills needs/creates needs, control/chaos, whereas the latter argued four paradoxes existed: efficiency/inefficiency, fulfills needs/creates needs, control/chaos, competence/incompetence. Based on a proposed research model, Chae and Yeum (2010) demonstrated that efficiency/inefficiency, new/obsolete, empowerment/ enslavement, and engaging/disengaging were significantly related to stress about mobile technologies. Moreover, Zhuang et al. (2013) empirically found that the paradoxes arising from the use of social networking sites involved assimilation/isolation and competence/incompetence. Lee and Rha (2016) proposed that the personalization-privacy paradox significantly affected internal conflict and the continued use intentions towad mobile commerce. Additionally, by integrating technology paradoxes and technology readiness, Park and Zhang (2021) demonstrated that customers ready to use unmanned convenience stores perceive the satisfiers of technology paradoxes more.

While considerable theoretical effort has been put into technology paradoxes, no studies on the paradoxes of FRT users are available, especially with empirical methods. As mentioned above, FRT users are also experiencing paradoxical perceptions because of the pros and cons of FRT. For example, as there is no need to enter a password, FRT can help users save time. However, the efficiency and accuracy of recognition are also affected by many factors, such as make-up, the color of skin, aging, occlusion, and plastic surgery (Anwarul & Dahiya, 2020; Lohr, 2018; Ueda & Koyama, 2010). Thus, users may not only perceive the efficiency of FRT but also perceive its inefficiency. Another central issue is privacy. Face recognition data has been required to be additionally protected by relevant laws to protect privacy (Wilkinson, 2020). While those technology companies with access to personal

information have made their privacy policies, FRT users are still concerned about the misuse of personal information and privacy violations (Carpenter et al., 2018; Li et al., 2020; Morosan, 2019). Consequently, it is necessary to involve technology paradoxes to explore usage intention for FRT, especially focusing on two primary technology paradoxes—efficiency/inefficiency and private/public.

The COVID-19 pandemic spurs an increase in FRT use due to its safety, convenience, and ability to assist in maintaining physical distance. Insight into the antecedents influencing the behavior of FRT users and the role of their feelings is essential in the adoption and management of FRT. Although the ongoing crisis has increased the importance of FRT, the paradoxes that FRT users are experiencing have not been investigated. Therefore, the present study aims to empirically examine how technology paradoxes and self-efficacy influence the resistance of FRT in China's online microfinance platforms. By combing functional factors (efficiency/inefficiency), privacy-related factors, and psychological factors (self-efficacy), we proposed a theoretical model that reveals to managers, policymakers, and technology designers the underlying causes of users' resistance to FRT.

3.2.3 Self-efficacy

Self–efficacy is the principal concept of social cognitive theory, and it refers to one's judgment about one's capacity to undertake specific actions (Bandura et al., 1997). In terms of technology applications, self-efficacy refers to people's belief that they possess the necessary expertise and abilities to utilise technology (Holden & Rada, 2011). In this way, self-efficacy is one's judgment or estimation of his/her abilities rather than his/her actual abilities. Hence, this study defined self-efficacy as one's perception or judgment of his/her capability to use FRT. Researchers have introduced self-efficacy into the context of technology applications involving computers (Compeau & Higgins, 1995; Isman & Celikli, 2009; Kinzie et al., 1994), the internet (Lai, 2008; Torkzadeh & Van Dyke, 2001), mobile technologies (Abulibdeh & Hassan, 2011; Tilton & Hartnett, 2016; Yang, 2012), and robotics (Latikka et al., 2019; Turja et al., 2019).

Self-efficacy influences people's behavioral decisions and how much effort they put into

those behaviors, which is crucial for technology acceptance and adoption (Barling & Beattie, 1983). Previous studies have shown that self-efficacy positively affects consumers' attitudes and behavioral intentions toward new technology (Jokisch et al., 2020; Kumar et al., 2020; Mitzner et al., 2019; Ratten, 2013). People with high self-efficacy, according to these research, generally have a positive attitude. They are more open to new technologies due to their confidence in their ability to learn and use them (Conrad & Munro, 2008). Even though Moriuchi (2021) has shown that self-efficacy moderates the effect of behaviorial intentions on self-efficacy, there is not much evidence that self-efficacy has a direct or indirect effect on FRT usage intentions.

In addition, self-efficacy has also been proven to be related to perceived ease of use (Brown, 2002; Saadé & Kira, 2009), privacy concerns (Akhter, 2014; Dienlin & Metzger, 2016), and anxiety (Onyeizugbo, 2010; Powell, 2013). These relationships suggest that self-efficiency is also related to factors in the technology paradox framework, such as efficiency/inefficiency, private/public, as well as anxiety. For example, high self-efficiency can make people more confident in completing work and managing personal information efficiently. Furthermore, people with low self-efficacy may experience anxiety due to a lack of confidence in their ability to use technology, which makes them resistant to using new technologies. Accordingly, to examine the factors influencing technology acceptance, it is necessary to investigate the connections between self-efficacy and these factors (Ratten, 2013). To this end, we introduce self-efficacy to the technology paradox framework to assess how it interacts with other factors (efficiency/inefficiency, private/public, anxiety) and how it affects user resistance in direct or indirect ways.

3.3 Research model and hypotheses

Figure 3.1 provides our research framework with all variables—self-efficacy, technology paradoxes, anxiety, and resistance. Technology paradoxes here are comprised of efficiency, private, inefficiency, and public. The operational definitions of these constructs are shown in Table 3.2.

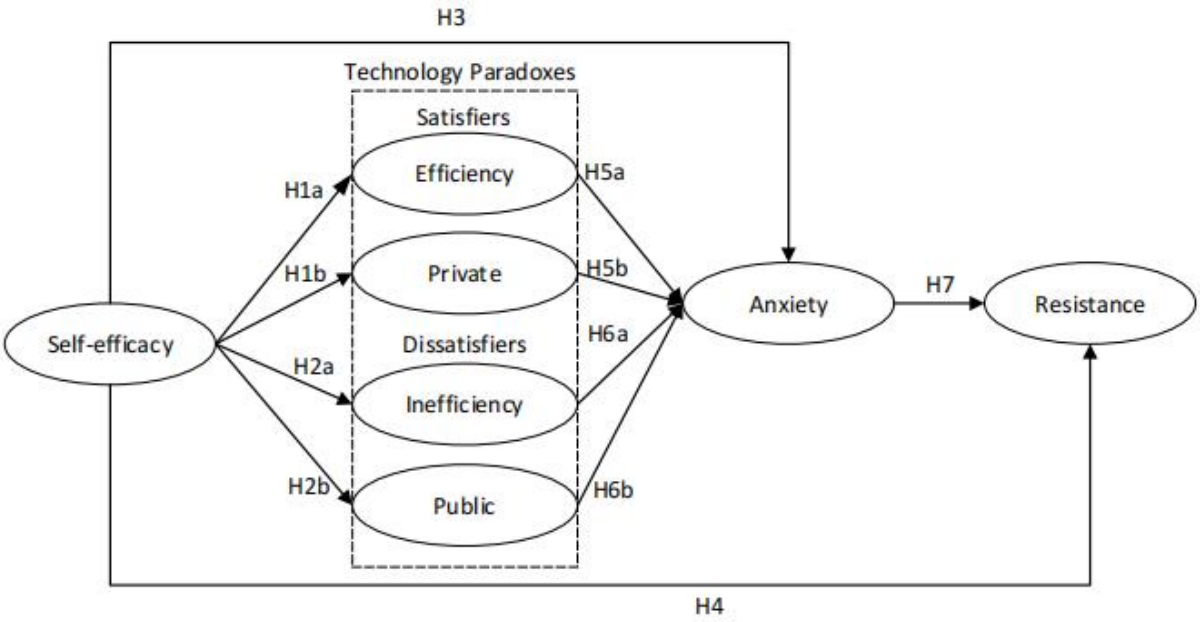

Figure 3.1 Research framework

Table 3.2 Operational definition

Constructs	Definition	Source
Self-efficacy	Confidence in one's capability to undertake specific actions.	Compeau and Higgins (1995)
Efficiency	When using a technology, users can perceive they spend less effort or time on certain activities.	Mick and Fournier (1998)
Inefficiency	When using a technology, users can perceive they spend more effort or time on certain activities.	Mick and Fournier (1998)
Private	When using a technology, users can perceive control over the disclosure and subsequent use of personal information.	Xu et al. (2008)
Public	When using a technology, users can perceive privacy risks or losses resulting from the internet disclosure of personal information.	Xu et al. (2008)
Anxiety	Fear, sadness, tension, and other negative emotions or feelings caused by some stressful situations.	Spielberger (1983)
Resistance	A natural psychological state in which the perceived consequences (e.g., loss of power) are unfavorable.	Ang and Pavri (1994); Kang and Kim (2009)

According to self-efficacy theory, one's confidence in his/her capacity to use technology influenced by self-efficacy serves as the basis for judging the difficulty of using certain technologies (Bandura, 1977, 1982; Wood & Bandura, 1989). Self-efficacy has been shown to have positive impacts on perceived ease of use in previous studies. (Abdullah & Ward, 2016; Agudo-Peregrina et al., 2014; Chen et al., 2011; Hu et al., 2003; Zheng & Li, 2020). Individuals with high self-efficacy have more confidence in their skills to execute tasks quickly and efficiently than those with low self-efficacy. (Akhter, 2014). Furthermore, it has been discovered that self-efficacy lowers the privacy risk perceptions. (Chen & Chen,

2015; Dienlin & Metzger, 2016) and privacy concerns (Zhang et al., 2018b). Generally, individuals with high self-efficacy have the confidence to control their privacy and resolve issues as they use technologies. Therefore, high self-efficacy makes consumers less concerned about privacy and more willing to provide personal information to use a novel technology (Lee & Rha, 2016; Wasko & Faraj, 2005). Hence, the following hypotheses were proposed:

H1. Self-efficacy has positive associations with the satisfiers of technology paradoxes.

H1a. Self-efficacy has a positive association with efficiency.

H1b. Self-efficacy has a positive association with private.

H2. Self-efficacy has negative associations with the dissatisfiers of technology paradoxes.

H2a. Self-efficacy has a negative association with inefficiency.

H2b. Self-efficacy has a negative association with public.

Moreover, one's emotional reactions, such as anxiety and stress, are also associated with self-efficacy perceptions (Bandura, 1977; Hayashi et al., 2004; Moriuchi, 2021). Anxiety arises when people need to learn new technologies or applications. Having the competencies and confidence required to learn and use technology can reduce anxiety levels. According to Cazan et al. (2016) and Muris (2002), if an individual is confident in completing a task, he/she will have a positive mood. In contrast, individuals with low levels of self-efficacy often suffer from anxiety and panic due to the belief that they are incompetent. Previous studies have supported this negative relationship between self-efficacy and anxiety in terms of computer use (Durndella & Haagb, 2002; Ekizoglu & Ozcinar, 2010; Igbaria et al., 1995; Powell, 2013). Therefore, we proposed that:

H3. Self-efficacy has a negative association with anxiety.

Furthermore, early studies have found self-efficacy to influence one's attitude and usage intention toward technology (Celik & Yesilyurt, 2013; Gürcan, 2005; Jokisch et al., 2020; Lam & Lee, 2006; Mitzner et al., 2019). According to Ellen et al. (1991), regardless of whether the new technology is satisfactory, people with poor feelings of low self-efficacy

are more likely to reject it in favor of alternatives they can manage and control. That is because feelings of low self-efficacy can cause anxiety and unease due to people's lack of confidence in their ability to manipulate new technologies. Therefore, when people do not have the confidence to be competent in learning and using new technologies, they tend to resist them. On the other hand, they may also choose to resist change to minimize anxiety and stress as a result of their lack of confidence (Tsai et al., 2020). That is, self-efficacy can not only affect resistance directly but also affect it through anxiety. Thus, we provided the following hypotheses:

H4. Self-efficacy has a negative association with resistance.

Technological products not only facilitate less effort or time but also lead to more effort or time (Mick & Fournier, 1998). Since no contact or physical interaction is required, using FRT can be very convenient and efficient for the end-users (Elloumi et al., 2021). It allows users to complete payments within a few seconds and dramatically improves efficiency (Zhong et al., 2021). However, users can also perceive inefficiency in poor conditions (e.g., angle, lighting, and distance of the subject to the camera) (Davis, 2014). Besides, despite the protection of some laws and policies, privacy issues arising from the use of FRT are still a major concern (Bowyer, 2004; Naker & Greenbaum, 2017; Raji et al., 2020). Thus, consumers can perceive the benefits (efficiency and private) of FRT and its potential adverse impacts (inefficiency and public) simultaneously (Introna & Nissenbaum, 2010).

Paradoxical situations encountered by technology users can provoke negative feelings, including anxiety and stress (Lee & Rha, 2016). According to Mick and Fournier (1998), anxiety and stress are likely to be stimulated by the conflict and ambivalence resulting from technology paradoxes. Specifically, the significant relationship between efficiency/inefficiency and anxiety/stress about mobile technology was confirmed quantitatively by Chae and Yeum (2010). In addition, the results of an interview undertaken by Bulmer et al. (2018) also revealed that the negative dimensions of technology paradoxes can evoke anxiety and stress to some extent. Similarly, with a qualitative approach, Wilson-Nash and Tinson (2021) found the effect of technology paradoxes on the elderly's emotions of conflict and anxiety in the use of digital technology. Drawing on this theoretical

mechanism, we proposed that:

H5. The satisfiers of technology paradoxes have negative associations with on anxiety.

H5a. Efficiency has a negative association with anxiety.

H5b. Private has a negative association with anxiety.

H6. The dissatisfiers of technology paradoxes have positive associations with anxiety.

H6a. Inefficiency has a positive association with anxiety.

H6b. Public has a positive association with anxiety.

Anxiety is fear, sadness, tension, and other negative emotions or feelings caused by some stressful situations (Spielberger, 1983). Computer anxiety corresponding to computer use refers to various negative emotions or feelings (e.g., fear, sadness, and tension) experienced when an individual is considering using or really applying computer technology (Maurer, 1994; Scott & Rockwell, 1997; Simonson et al., 1987). As mentioned above, it may result from a lack of confidence or experience in effectively operating a computer (Oyedele & Simpson, 2007). Another broader concept stemming from computer anxiety is technology anxiety. This anxiety focuses on the negative thoughts or feelings related to all general technological tools (Abdullah & Ward, 2016; Meuter et al., 2003). Therefore, in this study, the concept "anxiety" refers to "technology anxiety," which is the negative emotions or feelings that people have when they are thinking about or actually using FRT.

According to Compeau and Higgins (1995), users tend to avoid behaviors that cause anxiety. A voluminous body of research has empirically revealed that anxiety negatively influences usage intention (Cazan et al., 2016; Ekizoglu & Ozcinar, 2010; Lu & Su, 2009; McFarland & Hamilton, 2006; Meuter et al., 2003). For example, based on TAM, McFarland and Hamilton (2006) found that computer usage intention is significantly affected by computer anxiety. Similarly, Lu and Su (2009) argued that anxiety is an obstacle to using innovative systems, and they found that it is negatively related to a customer's intention to adopt mobile phones. Other scholars, such as Celik and Yesilyurt (2013) and Patil et al. (2020), indicated that anxiety negatively predicts users' attitudes toward

technology. Despite extensive research on the relationship between anxiety and usage intention, few studies have explored this relationship in FRT usage settings. Furthermore, the current study adopted another construct—resistance instead of usage intention. Hence, we proposed the hypothesis as follows:

H7. Anxiety has a positive association with resistance.

3.4 Research methods

3.4.1 Sample

An online survey was conducted to explore the antecedents influencing the resistance of FRT, and the target participants were those who had experience of using the microfinance platforms in China. Besides, the survey added a series of questions for screening to ensure participants' experience with microfinance platforms. After filtering, 418 of the 542 questionnaires that were distributed were found to be valid.

Table 3.3 shows the respondents' demographic characteristics. Out of the 418 respondents, 186 (44.5%) were males, and 232 (55.5%) were females. According to the table, the 21–30 age group, which is 53.6%, has the most participants; the 31–40 age group is next with 37.3%, while participants over 40 and under 21 are 6.7% and 2.4%, respectively. Besides, the majority of participants have a bachelor's degree (70.3%). The demographic profile showed that our sample is primarily made up of young and educated respondents with innovative mindsets. The gender, age, and education distribution levels are consistent with the distribution of general consumers of online microfinance platforms in China. Indeed, the consumers of online microfinance platforms in China are mainly young and educated people who are also intense users of mobile phones and mobile payments (Ma et al., 2018; Qiu et al., 2019; Zhang et al., 2018a). Moreover, according to statistics, there are slightly more females than males who use microfinance platforms like Alibaba in China (Zhang et al., 2018a). As for the usage frequency of the microfinance platforms, 34.4% of respondents used microfinance platforms 2–5 times per year, and 28.7% used them 6–10 times per year. Among the respondents, 27.3% had used the facial recognition function of microfinance platforms before, and 71.7% had heard about it, though they had never used it.

Table 3.3 Sample characteristics

Characteristics	Frequency	Percentage (%)
Gender		
Female	232	55.5
Male	186	44.5
Age		
20 years or less	10	2.4
21-30 years	224	53.6
31-40 years	156	37.3
41 years or above	28	6.7
Education		
High school or below	25	6.0
College degree	60	14.4
Bachelor degree	294	70.3
Graduate degree	39	9.3
Microfinance platforms usage per year		
1 time	64	15.3
2-5 times	144	34.4
6-10 times	120	28.7
10 times or above	90	21.5
Have you heard of or used FRT?		
Never heard of	4	1.0
Heard of it but never used it	300	71.7
Have used it before	114	27.3

3.4.2 Measurement

The formal questionnaire is comprised of 21 questions corresponding to each construct (see Appendix 3.1). All questions were assessed with a 7-point Likert scale, ranging from "1 = strongly disagree" to "7 = strongly agree". We initially undertook a pre-test to ensure the quality of the questionnaire. Subsequently, the questionnaire was modified by adjusting the questions that were not easy to understand. As for these measurement items, we referenced prior research and adapted them to the context of FRT usage in microfinance platforms.

3.4.3 Data analysis

In this paper, the two-step procedure of structural equation modeling (SEM) analysis (Anderson & Gerbing, 1988) was performed using AMOS 24 and SPSS 23. First, we examined the measurement model based on confirmatory factor analysis (CFA), including model fit indices, reliability, convergent validity, and discriminant validity. Afterward, we evaluated the structural model by testing our hypotheses. In addition, the mediating effects of technology paradoxes and anxiety between self-efficacy and resistance were tested.

3.5 Results

3.5.1 Measurement model

To evaluate the model fit indices, we employed several common indicators, including the ratio of chi-square to degrees-of-freedom (χ2/d.f.), comparative fit index (CFI), goodness-of-fit index (GFI), Tucker–Lewis index (TLI), normed fit index (NFI), parsimony comparative fit index (PCFI), parsimony goodness-of-fit index (PGFI), and root mean square error of approximation (RMSEA). As observed, χ2/d.f. was within the acceptable limit of 3.0 (Kline, 2015; Tabachnick et al., 2007). Otherwise, CFI, GFI, TLI, and NFI all above the 0.9 criterion. (Bentler & Bonett, 1980; Hu & Bentler, 1999; Wang & Chiu, 2011). The respective values of PCFI and PGFI were above the recommended threshold of 0.5 (Mulaik, 2009). McDonald and Ho (2002) also suggested that RMSEA values below 0.05 indicate a "good" fit, while values below 0.08 indicate an "acceptable" fit. The RMSEA value in this research was 0.039. Overall, the model fit indexes shown in Table 3.4 indicated that the measurement model was fitted to our data well.

Table 3.4 Fit indices for measurement and structural models

Fit index	Recommended level	Measurement model	Structural model
χ2/d.f.	< 3.0	1.639	2.279
CFI	> 0.9	0.986	0.970
GFI	> 0.9	0.942	0.918
TLI	> 0.9	0.982	0.964
NFI	> 0.9	0.965	0.948
PCFI	> 0.5	0.789	0.822
PGFI	> 0.5	0.685	0.707
RMSEA	<0.05 (good fit) < 0.08 (acceptable fit)	0.039	0.055

Notes: χ2/d.f. - chi-squared to degrees of freedom; CFI - comparative fit index; GFI - goodness-of-fit index; TLI- Tucker–Lewis index; NFI - normed fit index; PCFI - parsimony comparative fit index; PGFI - parsimony goodness-of-fit index; RMSEA - root mean square error of approximation.

As for reliability, we calculated the value of Cronbach's α to ensure the internal consistency of each construct. Generally, its value varies from 0 to 1, and the greater it is, the better. According to Hair et al. (2010), values of 0.6 to 0.7 are acceptable, and values above 0.7 are considered to be excellent. The Cronbach's α values of efficiency, inefficiency, private, public, self-efficacy, anxiety, and resistance were 0.851, 0.864, 0.915, 0.937, 0.857, 0.897.

and 0.905, respectively (see Table 3.5). It could be seen that all the values were above 0.8. This result, therefore, indicated the excellent reliability of the model.

To examine convergent validity, we followed three criteria recommended by Hair et al. (2010) and Fornell and Larcker (1981): a) factor loadings should be above 0.7; b) each construct's composite reliability (CR) should exceed 0.7; and c) each construct's average variance extracted (AVE) should be above 0.5. From Table 5, all CR and factor loadings values were above 0.7. The AVE values were all over 0.6. Accordingly, the level of convergent validity was also satisfactory.

Table 3.5 Reliability and convergent validity

Construct	Item	Factor Loading	SMC	Cronbach's Alpha	CR	AVE
Efficiency	EF1	0.862	0.743	0.851	0.852	0.659
	EF2	0.747	0.558			
	EF3	0.822	0.676			
Inefficiency	IE1	0.828	0.686	0.864	0.864	0.68
	IE2	0.829	0.687			
	IE3	0.817	0.667			
Private	PR1	0.904	0.817	0.915	0.915	0.782
	PR2	0.88	0.774			
	PR3	0.869	0.755			
Public	PU1	0.914	0.835	0.937	0.939	0.836
	PU2	0.914	0.835			
	PU3	0.915	0.837			
Self-efficacy	SE1	0.872	0.76	0.857	0.858	0.669
	SE2	0.791	0.626			
	SE3	0.788	0.621			
Anxiety	A1	0.897	0.805	0.897	0.901	0.754
	A2	0.922	0.85			
	A3	0.779	0.607			
Resistance	R1	0.857	0.734	0.905	0.905	0.761
	R2	0.904	0.817			
	R3	0.856	0.733			

Notes: AVE - Average variance extracted; SMC - Squared multiple correlations.

The Fornell-Lacker criterion (Fornell & Larcker, 1981), one of the most commonly used criteria, was used to assess discriminant validity. This criterion suggests that the square root of AVE should be above the correlation coefficient of the constructs. Table 3.6 showed that this requirement was met, indicating favorable discriminant validity of the measurement model.

Table 3.6 Discriminant validity of the construct

Construct	Efficiency	Inefficiency	Private	Public	Self-efficacy	Anxiety	Resistance
Efficiency	0.812						
Inefficiency	-0.719	0.825					
Private	0.655	-0.601	0.884				
Public	-0.446	0.643	-0.698	0.914			
Self-efficacy	0.766	-0.658	0.801	-0.654	0.818		
Anxiety	-0.518	0.692	-0.678	0.832	-0.754	0.868	
Resistance	-0.716	0.694	-0.787	0.734	-0.879	0.852	0.872

Notes: Diagonal values are the square root of average variance extracted （AVE）. Off-diagonal values are the correlation estimates.

3.5.2 Structural model

We used the same fit criteria to evaluate the structural model. As shown in Table 3.4, the values of $\chi 2$/d.f., CFI, GFI, TLI, NFI, PCFI, PGFI, RMSEA were 2.279, 0.970, 0.918, 0.964, 0.948, 0.822, 0.707, 0.055, respectively. It showed that all these fit indexes met the recommended criteria.

Our research model and the results of hypothesis testing are exhibited in Figure 3.2 and Table 3.7. It turned out that all the hypotheses were strongly supported (significant at *p*-value < 0.01), except for H5 (H5a and H5b). As expected, self-efficacy was shown to be positively associated with efficiency ($\beta = 0.796$, $p < 0.001$) and private ($\beta = 0.844$, $p < 0.001$) and a negative association with inefficiency ($\beta = -0.731$, $p < 0.001$), public ($\beta = -0.707$, $p < 0.001$), anxiety ($\beta = -0.626$, $p < 0.001$), and resistance ($\beta = -0.666$, $p < 0.001$). Hence, the hypotheses H1, H2, H3, and H4 were accepted. Besides, the positive associations of inefficiency ($\beta = 0.159$, $p < 0.01$) and public ($\beta = 0.493$, $p < 0.001$) with anxiety were supported, whereas efficiency ($\beta = 0.22$, $p < 0.01$) and private ($\beta = 0.134$, $p > 0.05$) did not share the hypothesized association with anxiety. In contrast, anxiety was found to be positively influenced by efficiency and to have no relationship with private. Therefore, H5 was rejected and H6 was accepted. Finally, the hypothesized positive association of anxiety with resistance ($\beta = 0.317$, $p < 0.001$) was confirmed. H7 was also accepted.

The percentage variance of resistance was 88%, indicating the strong predictive power of the proposed model. Besides, the percentage variances of efficiency, private, inefficiency, and public explained by self-efficacy were 63%, 71%, 53%, and 50%, respectively. Together, self-efficacy, efficiency, private efficiency, inefficiency, and public efficiency explained 80% of the variance in anxiety.

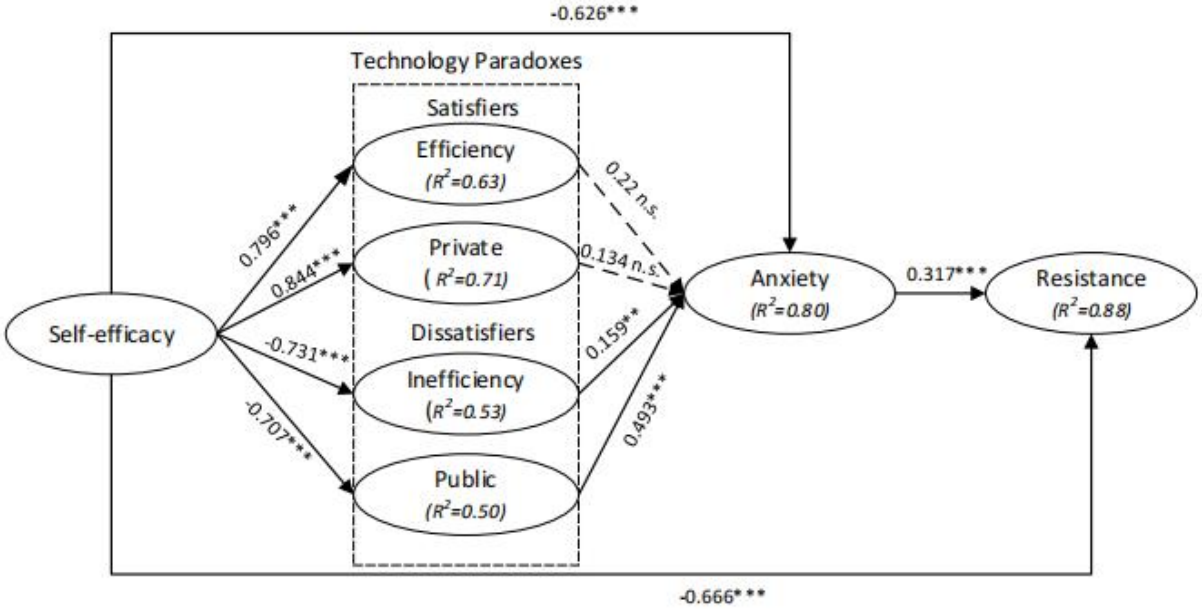

Figure 3.2 Results of hypothesis testing. Notes: ***p < 0.001; **p < 0.01; *p < 0.05.

Table 3.7 Results of hypothesis testing

Hypothesis	Path	Estimate	S.E.	t-value	p-value	Conclusion
H1a	Self-efficacy → Efficiency	0.796***	0.06	13.973	0.000	Supported
H1b	Self-efficacy → Private	0.844***	0.079	15.595	0.000	Supported
H2a	Self-efficacy → Inefficiency	-0.731***	0.074	-12.647	0.000	Supported
H2b	Self-efficacy → Public	-0.707***	0.09	-13.529	0.000	Supported
H3	Self-efficacy → Anxiety	-0.626***	0.21	-4.955	0.000	Supported
H4	Self-efficacy → Resistance	-0.666***	0.10	-10.487	0.000	Supported
H5a	Efficiency → Anxiety	0.22**	0.113	3.101	0.002	No supported
H5b	Private → Anxiety	0.134	0.085	1.787	0.074	No supported
H6a	Inefficiency → Anxiety	0.159**	0.071	2.899	0.004	Supported
H6b	Public → Anxiety	0.493***	0.054	8.867	0.000	Supported
H7	Anxiety → Resistance	0.317***	0.052	5.812	0.000	Supported

Notes: ***p < 0.001; **p < 0.01; *p < 0.05.

3.5.3 Testing of mediating effects

Based on the bootstrapping technique, this research further verified the effects of mediators.

The parameters set are as follows: a) 5000 bootstrap samples; b) 95% bias-corrected confidence interval (CI); and c) 95% percentile confidence interval (CI). The significant mediating effects could be confirmed if the 95% confidence interval does not involve zero (Chen & Xu, 2019). With reference to this requirement, three sets of mediators could be found (see Table 3.8). At first, self-efficacy had a positive effect on resistance via an indirect path from efficiency to anxiety (β = 0.087, Bias-corrected 95% CI = 0.027 to 0.182, Percentile 95% CI = 0.017 to 0.165). Second, self-efficacy has a negative effect on resistance via an indirect path from public to anxiety (β = -0.174, Bias-corrected 95% CI = -0.295 to -0.092, Percentile 95% CI = -0.288 to -0.089), or via anxiety (β = -0.312, Bias-corrected 95% CI = -0.527 to -0.169, Percentile 95% CI = -0.511 to -0.162).

Table 3.8 Results of mediating effects

Path	Indirect Effect	SE	Bias-corrected 95%CI			Percentile 95%CI		
			Lower	Upper	P	Lower	Upper	P
indS1	0.087	0.038	0.027	0.182	0.006	0.017	0.165	0.014
indS2	-0.058	0.041	-0.15	0.017	0.114	-0.132	0.029	0.205
indS3	0.056	0.042	-0.027	0.14	0.151	-0.033	0.136	0.181
indS4	-0.174	0.05	-0.295	-0.092	0.000	-0.288	-0.089	0.000
indS5	-0.312	0.091	-0.527	-0.169	0.000	-0.511	-0.162	0.000

Notes: indS1: Self-efficacy → Efficiency → Anxiety → Resistance; indS2: Self-efficacy → Inefficiency → Anxiety → Resistance; indS3: Self-efficacy → Private → Anxiety → Resistance; indS4: Self-efficacy → Public → Anxiety → Resistance; indS5: Self-efficacy → Anxiety → Resistance.

3.5.4 Model stability

To assess the stability of the model, we still utilized the bootstrap technique by recreating 500 samples from the original sample set through the AMOS software. This technique provides us with an effective way to ensure the stability of the path coefficients and correlations (Nedra et al., 2019). This study followed the two steps that Ievers-Landis et al. (2011) proposed to conduct the stability test. First, there should not be much difference (bias) between the mean bootstrap estimates and the original estimates. Second, the mean bootstrap samples' standard error (SE) should be above the SE-bias between the bootstrap samples and the original model. Table 3.9 showed that the bias was small since the mean bootstrap estimates were very close to the initial sample estimates; SE-bias for each path

was less than SE. Thus, the study concluded that the estimated model was stable and unbiased.

Table 3.9 Bootstrapped standardized regression weights

Correlations	Original estimate	Mean bootstrap estimate	Difference (Bias)	SE	SE-bias
Self-efficacy → Efficiency	0.796	0.794	0.002	0.031	0.001
Self-efficacy → Private	0.844	0.843	0.001	0.023	0.001
Self-efficacy → Inefficiency	-0.731	-0.730	-0.001	0.051	0.002
Self-efficacy → Public	-0.707	-0.706	-0.001	0.032	0.001
Self-efficacy → Anxiety	-0.626	-0.630	0.004	0.144	0.006
Self-efficacy → Resistance	-0.666	-0.663	-0.003	0.068	0.003
Efficiency → Anxiety	0.220	0.214	0.006	0.091	0.004
Private → Anxiety	0.134	0.133	0.001	0.096	0.004
Inefficiency → Anxiety	0.159	0.148	0.011	0.108	0.005
Public → Anxiety	0.493	0.495	-0.002	0.073	0.003
Anxiety → Resistance	0.317	0.319	-0.002	0.069	0.003

Notes: SE: standard error

3.6 Discussion

The present study is a pioneer to evaluate the role of FRT in the microfinance context, especially microfinance customers' resistance toward FRT. It adds to the body of knowledge by creating a theoretical model that integrates the technology paradox framework (Jarvenpaa & Lang, 2005; Mick & Fournier, 1998) and self-efficacy theory (Compeau & Higgins, 1995). Besides, it turned out that this model had a good fit and strong predictive power. Our findings revealed that the antecedents—self-efficacy, technology paradoxes, and anxiety—were all related to usage intention toward FRT. In particular, we demonstrated two primary technology paradoxes related to FRT usage—efficiency/inefficiency and private/public.

First, the results of hypothesis testing showed that self-efficacy significantly influences technology paradoxes, anxiety, as well as resistance. These findings supported the social cognitive theory (Compeau & Higgins, 1995), which was consistent with previous research on how self-efficacy affects users' anxiety (Cazan et al., 2016) and usage intention for FRT (Li et al., 2020; Moriuchi, 2021). Although existing literature has shown the positive impact of self-efficacy on perceived benefits (Horacek et al., 2002) and perceived ease of use

(Abdullah & Ward, 2016; Zheng & Li, 2020), this study specifically revealed that self-efficacy could positively influence users' perception of efficiency and private (satisfiers of technology paradoxes). In contrast, the perception of inefficiency and public (dissatisfiers of technology paradoxes) could be negatively influenced by self-efficacy. These results mean that, in the case of FRT usage in microfinance platforms, customers with low self-efficacy tend to make negative judgments and be anxious. Also, they are reluctant to use the facial recognition of microfinance platforms.

More importantly, the results of the mediating effects test showed that self-efficacy also indirectly influenced resistance via efficiency, public, and anxiety. While prior studies have indicated self-efficacy significantly influences anxiety (Durndella & Haagb, 2002; Ekizoglu & Ozcinar, 2010; Powell, 2013), usage intention (Celik & Yesilyurt, 2013; Jokisch et al., 2020; Mitzner et al., 2019), few of them have discussed the role of anxiety in mediating the relationship between self-efficacy and resistance. This study also found the mediating role of technology paradoxes between self-efficacy and resistance for the first time. This finding implies that the effect of microfinance platform users' self-efficacy on resistance toward FRT can be mediated by their perception of efficiency, privacy issues, and anxiety.

Moreover, the current study suggested that the relationship between technology paradoxes (including efficiency, inefficiency, private and public) and anxiety varies. First, surprisingly, efficiency is positively related to anxiety. This result could imply that customers regard efficiency as a conflict rather than a benefit. Generally, the high efficiency of FRT could reflect technological progress that could generate anxiety (Mokyr et al., 2015). This is because the advancement of certain technologies often means that they will be more widely used. However, considering privacy and security issues are still unresolved, the wide application of FRT will increase users' anxiety. Second, it turned out that private cannot directly influence anxiety, which contradicted past research (Chae & Yeum, 2010). One possible reason for the insignificant relationship between private and anxiety is that although the privacy policies of microfinance platforms try to protect users' personal information, users are also concerned about the effectiveness and transparency of these policies (Gong et al., 2019). Therefore, even if users are aware of the privacy protection

offered by the platforms, their anxiety can not be reduced. Finally, consistent with existing studies (Bulmer et al., 2018; Wilson-Nash & Tinson, 2021), the dissatisfiers of technology paradoxes (both inefficiency and public) positively correlate with anxiety. It shows that customers of the microfinance platforms are more concerned about the inefficiency of FRT usage and the leakage personal information, which can invoke their negative feelings.

Finally, a positive correlation was found between anxiety and resistance, consistent with prior theories and research (Ekizoglu & Ozcinar, 2010; Lu & Su, 2009; McFarland & Hamilton, 2006; Meuter et al., 2003). However, in terms of FRT application, research taking anxiety into consideration is scarce. Although Rasiah and Yen (2020) assumed anxiety was a crucial determinant affecting usage intention for biometric authentication, this hypothesis was not confirmed. Similarly, while Gao et al. (2021) pointed out that anxiety played a crucial role in using FRT, they did not directly estimate its effect. This study addressed this gap by empirically demonstrating the positive relationship between anxiety and resistance to FRT in microfinance settings. In other words, for customers of the microfinance platforms, a high level of anxiety due to technology paradoxes (inefficiency and public) restrains them from using FRT.

3.7 Conclusions

3.7.1 Theoretical implications

Recently, FRT has been extensively applied in various areas, including online microfinance platforms. Despite an increasing volume of studies on the usage intention of FRT, literature focusing on users' acceptance or resistance to using FRT in the microfinance field is scarce. This research sets out to fill this gap by empirically exploring the antecedents of resistance behavior. Based on prior theories and studies, our research model that combines the technology paradox framework and self-efficacy theory was proposed. Besides, an online survey was conducted, and 418 valid questionnaires were received. Finally, based on the SEM analysis, we tested the measurement and structural models by using AMOS 24 and SPSS 23. To the best of the authors' knowledge, this is the first study analyzing behaviorial intentions to FRT on the basis of technology paradoxes. This research has profound

theoretical implications.

First, based on the technology paradox framework, this paper recognized two primary paradoxes (efficiency/inefficiency and private/public) and anxiety as the antecedents of resistance to FRT usage. Compared with existing studies (Ciftci et al., 2021; Liu et al., 2021), this study examined not only privacy-related factors but also functional factors (e.g., efficiency) and psychological factors (e.g., self-efficacy). The results also proved the existence of technology paradoxes experienced by microfinance customers when using FRT. In addition, this study verified the crucial role of anxiety in affecting FRT adoption by empirically demonstrating the positive relationship between anxiety and resistance to FRT. More importantly, it demonstrated the mediating role of technology paradoxes (efficiency and public) and anxiety between self-efficacy and resistance.

Second, the present study expanded the technology paradox framework by introducing the self-efficacy theory. As expected, resistance was influenced both directly and indirectly by self-efficacy. It highlighted the significance of psychological factors (e.g., self-efficacy, anxiety) in affecting users' adoption decisions. This research advances the literature on both microfinance and FRT applications by providing a quantitative understanding of how self-efficacy and technology paradoxes affect resistance. Additionally, considering the rationality and explanatory power of the research model, it can also serve as the baseline for exploring usage intention toward other emerging technologies.

3.7.2 Practical implications

Microfinance plays a key role in fighting against financial exclusion and promoting entrepreneurship in developing countries (Annim, 2012; Bassem, 2008). During the last decade, microfinance providers also greatly benefited from the advent of ICT applications, especially AI technologies focused on in this paper. These ICT tools can help microfinance providers improve efficiency, reduce costs, and alter the way individuals access financial services (Moro-Visconti, 2021). Considering the substantial contribution of ICT in the fight against COVID-19, there is an urgent need to examine the role of ICT in society and achieve its tremendous potential. The emerging microfinance platforms based on ICT have

been updating their functions and services, including introducing FRT. However, they must take customers' needs into consideration to provide efficient and effective financial services. It is necessary to analyze whether and how FRT can be promoted from the customer's perspective. This study has significant practical implications and sheds new light on the issues regarding Chinese users' resistance toward FRT. It also provides guidelines for microfinance providers, government agencies, and technology designers.

First, this study helps microfinance providers to understand the paradoxes experienced by FRT users and take corresponding measures. On the one hand, efficiency and profitability have become central issues for microfinance in the increasingly competitive environment (Kauffman & Riggins, 2012). However, microfinance providers should not only improve their own efficiency but also consider their customers' perceptions of efficiency. In addition, while a range of privacy regulations and practices related to privacy have been launched to protect personal information, microfinance customers are still worried about privacy leakage and are reluctant to use FRT. As a result, microfinance platforms and the government should not only advance relevant laws and policies but also give customers control over their personal information. For example, microfinance platforms could inform users of what and how personal information will be used in detail to ensure the effectiveness and transparency of privacy policies. Besides, policymakers need to modify long and complicated clauses to make them easier for ordinary people to understand (Zheng, 2021).

Moreover, it raises awareness of the importance of users' confidence or self-efficacy in using FRT. To build customers' confidence and ease their anxiety, microfinance providers need to increase the frequency of FRT use through rewards and other ways and provide users with the necessary education and training to encourage them to use FRT (Salanova et al., 2000). For example, the platforms could provide a guide to FRT usage (including solutions when problems arise) and direct customers to search for and read it. In addition, a good customer experience can also enhance users' confidence to continue using. Therefore, microfinance providers should turn their attention to the users' experience mentioned above. In summary, all these measures will effectively mitigate users' anxiety, which in turn

influences customers' behavioral intentions toward the facial recognition function of microfinance platforms.

Technology designers can benefit from this research by getting a better understanding of users' needs, thereby improving FRT performance and promoting its usage. To enhance the effectiveness of FRT systems, on the one hand, they should refine existing datasets and continuously test the system to recognize faces of different genders and skin tones (Garvie & Frankle, 2016). On the other hand, technology designers should continue to update the FRT system to adapt to a range of constraint factors, such as angle, lighting, facial expression, and make-up (Davis, 2014). In addition, this study suggests that technology designers should make a trade-off between efficiency and privacy. It encourages designers to take both system functionality and its impacts on users' privacy into consideration (Lahlou et al., 2005).

3.7.3 Limitations and further research

There are a few limitations deserving further research: First, the generalisability of these findings is limited as this study focuses on FRT users of the online microfinance platforms in China. Future work across different countries and sectors is needed to validate these research findings. Second, the majority of our sample is composed of young and highly educated people, who may be more receptive to FRT due to their familiarity with the internet and mobile technologies. This makes this study less generalizable to the usage intentions of the average FRT users. Accordingly, the usage intentions of the elderly, less educated, and other potential users should be further discussed. Third, while many factors affect the usage intention toward FRT, this study merely examined the framework integrating technology paradoxes and self-efficacy. Based on the technology paradox framework, only "anxiety", a negative factor, was included in our research model. Hence, future research could take some positive factors (e.g., "liking", "satisfaction", and "trust") into consideration beyond this framework. Fourth, given that this study only assumed that technology paradoxes affect resistance through anxiety aligned with the technology paradox framework, future studies could further examine the direct relationships between them. Finally, our research results may be influenced potentially by some demographic

variables such as respondents' gender, age, education, and income. Compared with traditional banking users, microfinance users will also have differences in individual wealth. Future research should incorporate these variables as moderators to determine differences in consumer samples.

Appendix 3.1 Measurement items

Construct	Questionnaire Items	Adapted from
Efficiency	EF1. Using the facial recognition function of microfinance platforms improves my efficiency. EF2. Using the facial recognition function of microfinance platforms enables me to access the microfinance platforms faster. EF3. Most of the time, using the facial recognition function of microfinance platforms is convenient to use.	Garrity (2012); Park and Zhang (2021)
Inefficiency	IE1. Figuring out how to use the facial recognition function of microfinance platforms is usually too time-consuming. IE2. Using the facial recognition function of microfinance platforms always seems to take longer than I expected. IE3. Using the facial recognition function of microfinance platforms is often more complicated than needs to be.	Garrity (2012); Park and Zhang (2021)
Private	PR1. If I use the facial recognition function of microfinance platforms, I believe that how these platforms use my personal information is in my control. PR2. If I use the facial recognition function of microfinance platforms, I believe that what personal information is released by microfinance platforms is in my control. PR3. If I use the facial recognition function of microfinance platforms, I believe that I can control my personal information provided to the microfinance platforms.	Liu et al. (2021); Xu et al. (2008)
Public	PU1. Using the facial recognition function of microfinance platforms makes me worried about the amount of personal information acquired by microfinance platforms. PU2. Using the facial recognition function of microfinance platforms makes me worried that my personal data might be accessed by unauthorized persons. PU3. Using the facial recognition function of microfinance platforms makes me worried that my personal data might be misused by microfinance platforms.	Liu et al. (2021); Xu et al. (2008)
Resistance	R1. I am reluctant to utilize the facial recognition function of microfinance platforms. R2. I insist on using passwords rather than the facial recognition function of microfinance platforms. R3. I would not recommend the facial recognition function of microfinance platforms to others.	Liu et al. (2021); Kang and Kim (2009); Lee (2020);
Self-efficacy	SE1. I am sure that I have the ability to overcome difficulties brought by the facial recognition function of microfinance platforms. SE2. Compared with others, I have the confidence to conduct any type of transaction through face recognition and any other authorization method. SE3. I have the confidence to overcome certain difficult financial transactions due to the use of the facial recognition function of microfinance platforms.	Moriuchi (2021)
Anxiety	A1. It makes me nervous to think about losing personal information due to incorrect use of the facial recognition function of microfinance platforms. A2. I am hesitant to use the facial recognition function of microfinance platforms because I'm afraid of making mistakes that I can't correct. A3. I fear that mistakes brought by the facial recognition function of microfinance platforms are potentially devastating.	Patil et al. (2020) Rana et al. (2017); Lu and Su (2009); Johnson et al. (2008)

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Chapter 4. The role of gamification in customer citizenship behavior in China's microfinance platforms[3]

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Chapter 4. The role of gamification in customer citizenship behavior in China's microfinance platforms

Abstract

This study systematically explores how customer value derived from gamification influences customer citizenship behavior within the microfinance sector. To validate our theoretical framework, we conducted an online survey targeting users of microfinance platforms in China. Subsequently, the partial least squares-structural equation modeling (PLS-SEM) analysis was performed on 405 valid data. The analysis reveals that functional and social values positively impact satisfaction, while emotional and monetary values do not exhibit a significant relationship with satisfaction. Additionally, satisfaction is positively associated with helpfulness, feedback, tolerance, and advocacy. More importantly, this study confirms the mediating role of satisfaction in the relationships between functional value, social value, and customer citizenship behavior. These insights offer valuable implications for microfinance platforms and the finance industry in improving user experience, fostering customer loyalty, and maximizing the value-creation potential of customers.

Keywords: Gamification, microfinance, customer value, customer citizenship behavior.

4.1 Introduction

In recent years, microfinance platforms, such as Alipay, JD Finance, and WeChat Pay, have redefined the landscape of China's financial sector and established themselves as a key player in the industry (GAO, 2022). By leveraging technological innovations, these platforms have diversified their offerings to include mobile payments, money transfers, financial management, and insurance services. While widely adopted for convenient access to financial services, these platforms also face intense competition in retaining customers (Zhang & Kim, 2020).

In response to the imperative of enhancing user experiences and engagement, microfinance platforms are actively embracing gamification as a strategic approach to bolster customer relationships. The infusion of playful elements, such as rewards, challenges, and interactive interfaces, aims to create a dynamic and enjoyable financial experience for users (Yathiraju & Dash, 2023). For instance, Alipay introduces the virtual savings challenge, where users earn rewards for consistently saving money through the platform. Additionally, the platform introduces financial literacy challenges to encourage users to improve their understanding of financial concepts and earn rewards for their achievements.

While gamification strategies gain traction among microfinance institutions for customer attraction and retention, the customer value they bring and their overall impacts have been insufficiently explored. Customer value has been suggested to play a vital role in increasing customer satisfaction and fostering a positive customer relationship with a product or service (Gallarza et al., 2019; Xu et al., 2015). Therefore, this study extends this understanding to the gamified microfinance setting, where functional, social, emotional, and monetary values play unique roles in shaping user perceptions.

Apart from engagement and loyalty to products and services, customers have been found to exhibit customer citizenship behaviors (CCB), such as helping other customers, offering feedback to improve service delivery, and making recommendations to friends or family (Groth, 2005). In fact, the growing significance of CCB in value creation has propelled it to the forefront within the financial sector. While existing research has started to explore the

effects of gamification on user engagement (Golrang & Safari, 2021; Lai & Langley, 2023; Raza et al., 2023), research on CCB within the financial domain is surprisingly scarce. Hence, this research endeavors to fill this void by investigating the intricate connections between gamified experiences, customer satisfaction, and voluntary behaviors that extend beyond fundamental financial transactions.

In summary, this study aims to explore the influence of gamification-induced customer value on CCB, with a specific focus on the mediating role of satisfaction. In particular, four distinct dimensions of consumers' gamified customer value are employed: functional value (FV), social value (SV), emotional value (EV), and monetary value (MV). Additionally, the concept of CCB in this study encompasses aspects such as helping, feedback, tolerance, and advocacy. This study significantly contributes to the existing body of knowledge by delving into the diverse customer value from gamification strategies within the microfinance sector. Besides, our study widens the research scope of CCB by identifying the antecedents of CCB in the gamified microfinance platform settings. Our empirical findings not only substantiate the strategic integration of gamified elements into microfinance platforms but also offer practical insights for creating additional value from customers while enhancing customer loyalty.

4.2 Theoretical background

4.2.1 Customer value

Zeithaml (1988) defined customer value as a customer's subjective assessment of the overall worth or appeal of a product or service. Similarly, Butz and Goodstein (1996) characterized it as an emotional connection that individuals establish with the provider of a product or service. This perception is influenced by the customer's assessment of the benefits received in relation to the costs incurred (McDougall & Levesque, 2000). These costs involve not only the monetary price but also time, effort, and any other sacrifices made to obtain or use the product or service. Given that customer value can shape a consumer's relationship with a product or service, it becomes a crucial aspect for marketers and researchers investigating consumer behavior (Garrouch & Ghali, 2023).

As proposed by Sweeney and Soutar (2001), customer value encompasses dimensions of performance/quality, as well as emotional, monetary, and social aspects. In alignment with previous research on customer value (Senić & Marinković, 2014; Wang et al., 2004; Zhang et al., 2017), the current study introduced functional, social, emotional, and monetary values into our framework for gamified microfinance platforms. Among these, FV derives from expected performance and represents the utility of a product or service (Lee et al., 2014). SV pertains to the enhancement of an individual's self-perception facilitated by a product or service. Besides, MV views value creation as paying less for goods, while EV is the utility derived from feelings induced by a product or service (Lee et al., 2014).

As highlighted in prior literature, customer value stands out as a pivotal determinant of customer satisfaction. For example, Xu et al. (2015) illustrated that both FV and EV exert a positive influence on customers' satisfaction with mobile apps based on a comprehensive data analysis involving 347 app users. Moreover, Gallarza et al. (2019) observed a significant impact of FV, EV, and SV on satisfaction in their study encompassing 340 hotel guests. Additionally, the positive association between MV and satisfaction also has been underscored in earlier research (Dardak & Habib, 2010; Shahijan et al., 2018). Drawing insights from these, we put forward the following:

H1. FV is positively correlated with satisfaction with microfinance platforms.

H2. SV is positively correlated with satisfaction with microfinance platforms.

H3. EV is positively correlated with satisfaction with microfinance platforms.

H4. MV is positively correlated with satisfaction with microfinance platforms.

4.2.2 Customer citizenship behavior (CCB)

CCB includes a set of voluntary and discretionary actions that extend beyond the mere consumption of products or services (Bettencourt, 1997; Ford, 1995). In the financial context, CCB can be defined as voluntary and discretionary behaviors undertaken by customers that go beyond the basic requirements of financial transactions (Yi & Gong, 2008). This includes activities such as assisting fellow customers, providing constructive feedback, demonstrating ethical financial practices, and actively advocating for the

financial institution.

In terms of CCB components, Tat Keh and Wei Teo (2001) introduced 'tolerance' as the willingness to patiently endure service discrepancies. Additionally, Groth (2005) outlined other three dimensions, including helping other customers, offering feedback to improve service delivery, and making recommendations to friends or family. Drawing from these insights, within this study, CCB involves helping, feedback, tolerance, and advocacy.

Due to its capacity to generate added value for organizations (Ford, 1995), CCB has garnered significant attention from scholars. For example, Cheng et al. (2016) explored the relationship between brand attachment and CCB, highlighting the importance of perceived value among loyal customers of international hotel brands in Taiwan. Kim et al. (2020) discovered a positive effect of corporate social responsibility activities on CCB. Additionally, Garrouch and Ghali (2023) examined the association between perceived values in mobile shopping apps and CCB based on the social exchange theory. They found that perceived values influence consumer well-being, subsequently predicting CCB.

In addition to the studies mentioned, other extensively studied antecedents of CCB include perceived support and justice, personality traits, satisfaction, and brand experience (Anaza, 2014; Choi & Lotz, 2018; Xie et al., 2017). In particular, Zhu et al. (2016) found that social support significantly affects CCB through customer satisfaction in online brand communities. Similarly, Zhu et al. (2021) identified that post-service satisfaction significantly affects the CCB of e-shoppers. The strong positive links between satisfaction and behaviors like helping, feedback, tolerance, and advocacy highlight satisfaction's pivotal role in fostering customer engagement and loyalty. Building on this theoretical foundation, we proposed the following hypotheses:

H5. Satisfaction with microfinance platforms is positively correlated with helping.

H6. Satisfaction with microfinance platforms is positively correlated with feedback.

H7. Satisfaction with microfinance platforms is positively correlated with tolerance.

H8. Satisfaction with microfinance platforms is positively correlated with advocacy.

4.3 Research design

4.3.1 Measurement

Figure 4.1 visually represents our research framework grounded in the previously discussed theoretical foundation. We customized measurement items from existing scholarly literature to assess our constructs: FV, SV, EV, MV, satisfaction, helping, feedback, tolerance, and advocacy. Moreover, to capture respondents' perceptions, each item associated with these constructs was rated on a 7-point Likert scale, ranging from "1 = strongly disagree" to "7 = strongly agree".

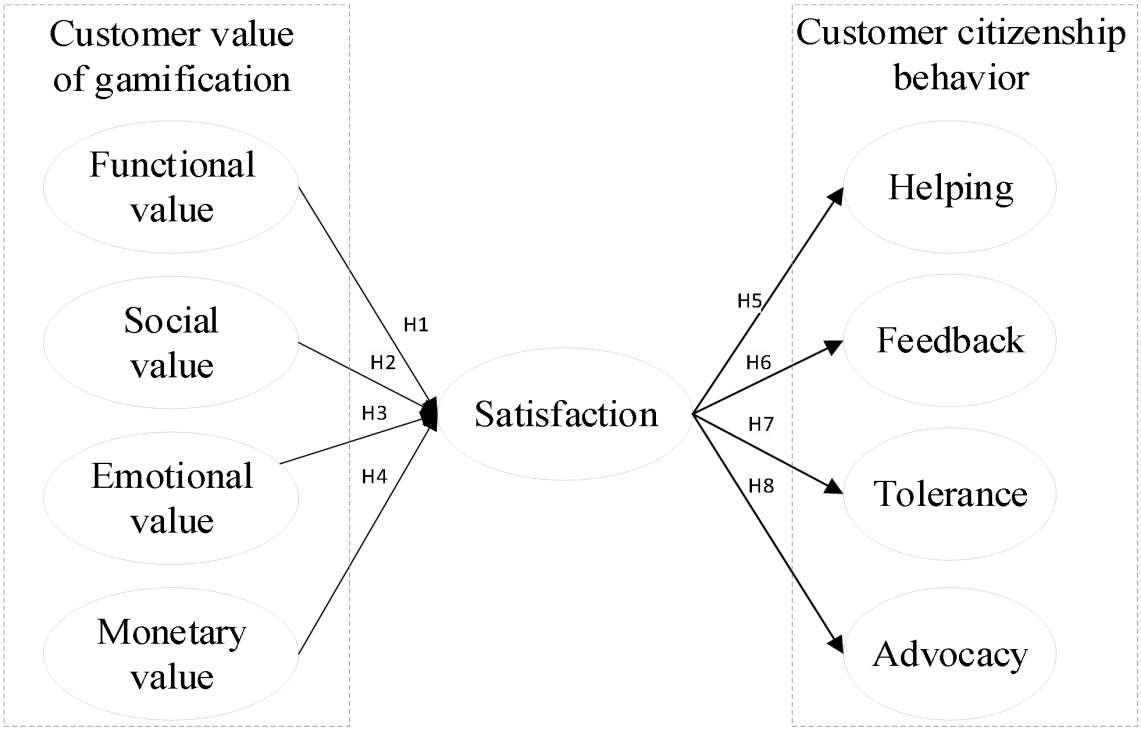

Figure 4.1 Research framework

4.3.2 Sampling and data collection

Our data were collected from a reputable survey platform in China and included individuals well-versed in online microfinance platforms. To ensure questionnaire relevance, we refined item wording based on pre-test feedback. The formal questionnaire, comprising 20 questions, addressed distinct constructs, with each question focusing on specific aspects (see Appendix 4.1). Through meticulous data quality measures, such as setting attention-

checking questions and manually screening for logical consistency, we ultimately obtained 405 valid samples.

In Figure 4.2, the gender distribution shows 35.80% male and 64.20% female participants. The majority fall within the 21-30 age group, constituting 51.60% of the sample, followed by the 31-40 age group at 38.77%. Furthermore, 79.51% of participants had a bachelor's degree, suggesting a younger and well-educated demographic. Regarding microfinance platform usage frequency, 60.74% use it every day, while 32.10% use it once a week.

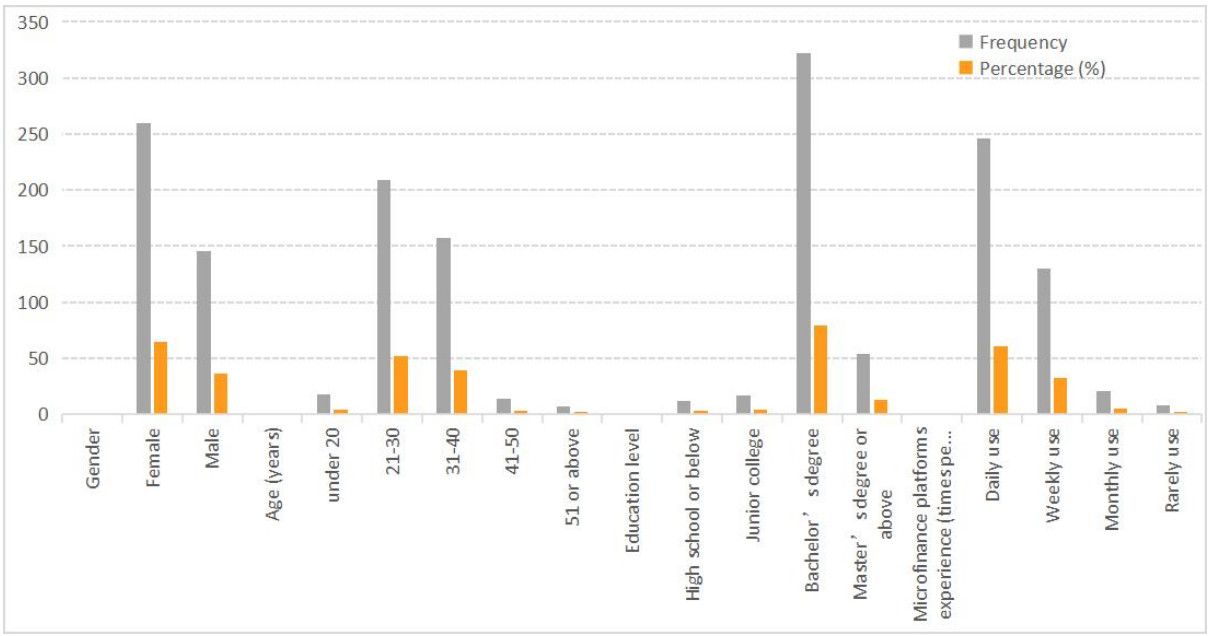

Figure 4.2 Sample characteristics

4.4 Results

Our research involved a two-step process performed by SmartPLS 3.3.9: initially assessing the measurement model to scrutinize reliability, convergent validity, and discriminant validity, followed by hypothesis testing to thoroughly examine the structural model.

4.4.1 Measurement model

We used tests for discriminant validity, convergent validity, and reliability to assess the measurement model. Cronbach's alpha values for each of the constructs in Table 4.1 are more than 0.6, suggesting that the measurement model has a reasonable degree of reliability

(Morgan et al., 2004). Additionally, the measurement model demonstrates strong convergent validity, with all composite reliability (CR) and average variance extracted (AVE) values surpassing the recommended criteria of 0.7 (Nunnally, 1994) and 0.5 (Fornell & Larcker, 1981), respectively.

As for discriminant validity, Table 4.2 matches the criteria of discriminant validity proposed by Hair Jr et al. (2017), with the square root of AVE for each construct surpassing its correlations with other constructs.

Table 4.1 Reliability and convergent validity

Construct	Cronbach's Alpha	Composite reliability	AVE
Functional value	0.783	0.860	0.606
Social value	0.800	0.870	0.627
Emotional value	0.703	0.819	0.532
Monetary value	0.723	0.827	0.546
Satisfaction	0.689	0.811	0.518
Helping	0.728	0.831	0.553
Feedback	0.623	0.798	0.569
Tolerance	0.854	0.912	0.774
Advocacy	0.739	0.851	0.657

Table 4.2 Discriminant validity

	FV	SV	EV	MV	Satisfaction	Helping	Feedback	Tolerance	Advocacy
FV	0.778								
SV	0.701	0.792							
EV	0.700	0.689	0.729						
MV	0.639	0.608	0.553	0.739					
Satisfaction	0.671	0.685	0.618	0.519	0.720				
Helping	0.658	0.668	0.647	0.506	0.606	0.744			
Feedback	0.624	0.651	0.535	0.488	0.578	0.623	0.754		
Tolerance	0.601	0.647	0.514	0.527	0.579	0.574	0.505	0.880	
Advocacy	0.698	0.722	0.621	0.613	0.615	0.690	0.672	0.574	0.810

4.4.2 Structural model

A bootstrapping procedure was conducted to test our hypotheses using 5000 samples. The results shown in Table 4.3 and Figure 4.3 indicate that FV ($\beta = 0.299$, $p < 0.001$) and SV ($\beta = 0.354$, $p < 0.001$) positively influence satisfaction. However, the hypothesized relationships between EV ($\beta = 0.146$, $p > 0.05$) and MV ($\beta = 0.035$, $p > 0.05$) with satisfaction were not statistically significant. Furthermore, satisfaction positively influences

helping (β = 0.606, p < 0.001), feedback (β = 0.578, p < 0.001), tolerance (β = 0.579, p < 0.001), and advocacy (β = 0.615, p < 0.001). Hence, most hypotheses are supported, except for H3 and H4.

Table 4.3 Hypothesis test results

Hypothesis	Path	Standardized path coefficient	t-value	p-value	Conclusion
H1	FV → S	0.299	4.054	0.000	Supported
H2	SV → S	0.354	3.976	0.000	Supported
H3	EV → S	0.146	1.878	0.060	No
H4	MV → S	0.035	0.547	0.584	No
H5	S → HP	0.606	13.645	0.000	Supported
H6	S → FE	0.578	15.740	0.000	Supported
H7	S → TE	0.579	15.763	0.000	Supported
H8	S → AY	0.615	14.737	0.000	Supported

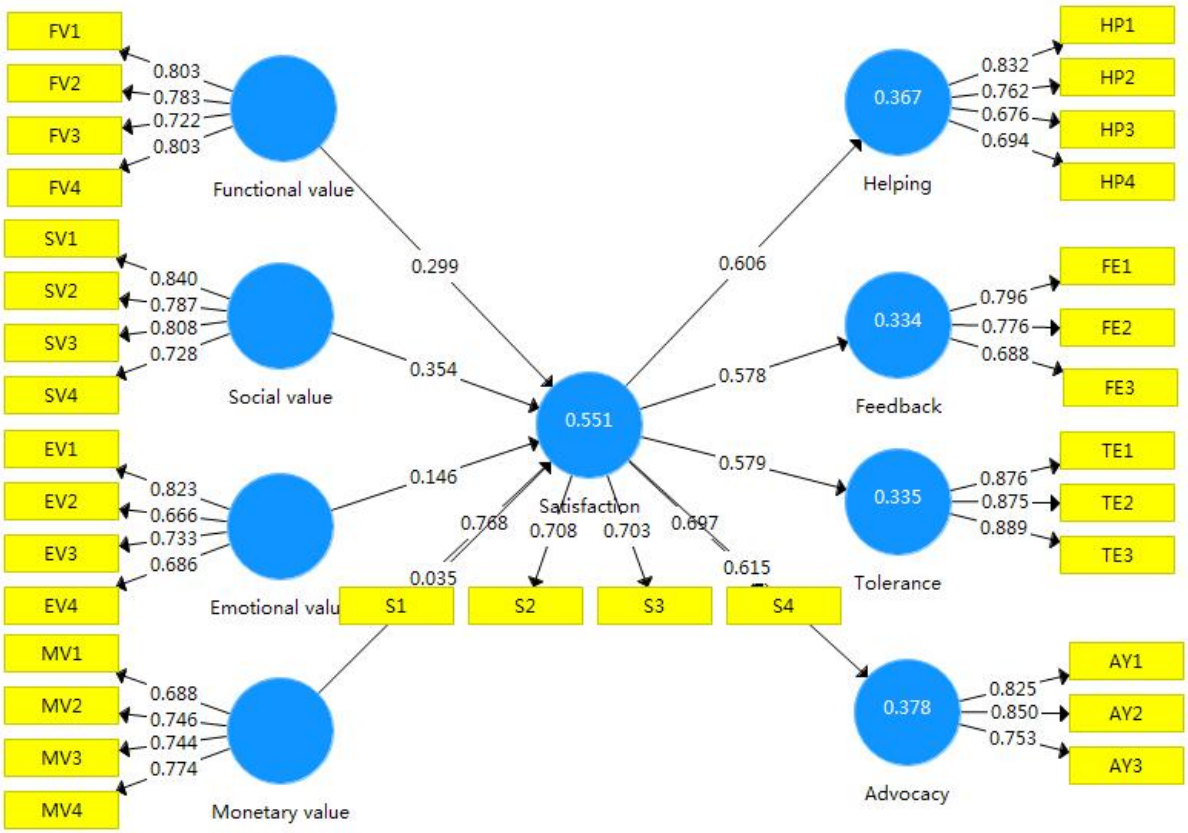

Figure 4.3 Results of hypothesis testing

4.4.3 Model valuation

Table 4.4 assesses the structural model's adequacy using three indicators: explained

variance (R^2), predictive relevance (Q^2), and goodness of fit (GoF). This model explains 55.1% of the variance in satisfaction and 36.7%, 33.4%, 33.5%, and 37.8% of the variance in helping, feedback, tolerance, and advocacy, respectively.

Moreover, the positive values of Q^2 for all endogenous variables indicate substantial predictive relevance (Henseler et al., 2012). The model fit, assessed by GoF, is calculated as 0.485, well above the recommended threshold of 0.36 for a large GoF (Tenenhaus et al., 2005). These results suggest that our structural model has robust explanatory and predictive capabilities, with an excellent overall fit.

$$\text{GoF} = \sqrt{\overline{AVE} \times \overline{R^2}} = \sqrt{0.598 \times 0.393} = 0.485$$

Table 4.4 Model evaluation metrics

	R^2	Adjusted-R^2	Q^2	GoF
Satisfaction	0.551	0.547	0.275	0.485
Helping	0.367	0.366	0.2	
Feedback	0.334	0.332	0.187	
Tolerance	0.335	0.333	0.256	
Advocacy	0.378	0.377	0.243	

4.4.4 Mediation effect testing

To test the mediation effects of satisfaction between customer value and CCB, the current research examined the specific indirect effect using the SmartPLS software. As shown in Table 4.5, the mediation effects of satisfaction between FV, SV, and the four dimensions of CCB were identified, with the specific indirect effects being both positive and statistically significant ($p < 0.001$). However, satisfaction did not serve as a mediator in the impact of EV and MV on the four dimensions of CCB since the specific indirect effects were not significant ($p > 0.05$).

Table 4.5 Summary of mediation effect results

	Original Sample	Sample Mean	Standard Deviation	t-value	p-value
FV > Satisfaction > Help	0.181	0.183	0.048	3.769	0.000
FV > Satisfaction > Feedback	0.173	0.174	0.046	3.771	0.000
FV > Satisfaction > Tolerance	0.173	0.173	0.044	3.913	0.000
FV > Satisfaction > Advocacy	0.184	0.185	0.050	3.660	0.000
SV > Satisfaction > Help	0.215	0.214	0.054	3.953	0.000

	Original Sample	Sample Mean	Standard Deviation	t-value	p-value
SV > Satisfaction > Feedback	0.205	0.203	0.053	3.896	0.000
SV > Satisfaction > Tolerance	0.205	0.204	0.056	3.632	0.000
SV > Satisfaction > Advocacy	0.218	0.216	0.053	4.087	0.000
EV > Satisfaction > Help	0.088	0.094	0.049	1.804	0.071
EV > Satisfaction > Feedback	0.084	0.088	0.045	1.871	0.061
EV > Satisfaction > Tolerance	0.084	0.087	0.044	1.915	0.056
EV > Satisfaction > Advocacy	0.090	0.094	0.049	1.827	0.068
MV > Satisfaction > Help	0.021	0.025	0.039	0.549	0.583
MV > Satisfaction > Feedback	0.020	0.024	0.037	0.552	0.581
MV > Satisfaction > Tolerance	0.021	0.023	0.037	0.556	0.578
MV > Satisfaction > Advocacy	0.022	0.026	0.040	0.551	0.582

4.5 Discussion

4.5.1 Key findings and implications

This study investigates how customer value from gamification influences customer satisfaction with microfinance platforms and subsequently shapes customer citizenship behaviors. This study enhances our understanding of the complex interplay between customer value, satisfaction, and citizenship behavior. More importantly, it provides practical guidelines for microfinance providers to effectively enhance user experience and generate additional value through customer relationships. Key findings include:

Firstly, our research highlights the significant influence of both FV and SV on customer satisfaction. This aligns with established literature that underscores the crucial role of utilitarian and social aspects in shaping customer perceptions (Evelina et al., 2020; Furukawa et al., 2019). This finding underscores that users of microfinance platforms prioritize the perceived utility and social relevance brought about by gamification. In light of this, microfinance providers have the opportunity to enhance customer satisfaction by strategically focusing on these two dimensions of value, thereby fostering a more tailored and enriched customer experience.

Secondly, the relationships between EV, MV, and satisfaction were not found to be significant, which is inconsistent with previous research (Deng et al., 2010; Slack et al., 2020). This may suggest that, in the specific context of the study, customers' assessments of

emotional and monetary aspects have a limited impact on their overall satisfaction. This unexpected finding underscores the importance of a nuanced understanding of customer preferences and urges microfinance institutions to consider multifaceted approaches to meet customer expectations.

Thirdly, our study establishes satisfaction as a positive driver of customer citizenship behavior, which is consistent with Novitasari et al. (2020) and Xu et al. (2022). The strong positive relationships between satisfaction and helping, feedback, tolerance, and advocacy highlight the pivotal role satisfaction plays in fostering customer engagement and loyalty. Thus, microfinance providers could work on developing business strategies for customer satisfaction, which not only retains loyal customers but also encourages them to actively contribute to these platforms through helping, feedback, tolerance, and advocacy.

Finally, satisfaction played a mediating role in connecting FV and SV to the various dimensions of CCB. The positive and significant specific indirect effects observed in these instances suggest that the impact of FV and SV on CCB was partially explained by the mediating variable of satisfaction. On the contrary, when it came to EV and MV, satisfaction did not serve as a mediator. The lack of significant specific indirect effects in these cases indicates that satisfaction did not play a substantial role in explaining the relationship between EV, MV, and the four dimensions of CCB.

4.5.2 Limitations and future research

First, a potential limitation of the study is the overrepresentation of participants holding bachelor's degrees. Future research should strive for a more diverse sample to improve the study's generalizability and applicability. Second, subsequent research could be valuable in expanding beyond the microfinance context to investigate these relationships in various regional and socio-economic settings. Lastly, our study provides a snapshot of customer experiences, and future research could employ a longitudinal approach to track the evolution of customer preferences and behaviors over time.

4.6 Conclusion

In China, microfinance platforms are rapidly gaining prominence and disrupting the

conventional operations of the traditional financial industry. To elevate the overall customer experience, these platforms are implementing various strategies, including the incorporation of gamification. This research systematically explores the connections between customer value derived from gamification and CCB, with a particular focus on examining the mediating role of satisfaction. Based on data obtained from 405 users of microfinance platforms, our research reveals that FV and SV positively impact user satisfaction. However, no statistically significant relationship was identified between emotional value, monetary value, and satisfaction. Additionally, satisfaction is shown to have a positive correlation with CCB, such as helpfulness, feedback, tolerance, and advocacy. More importantly, this study confirms the mediating role of satisfaction in the relationships between FV, SV, and CCB. These insights provide crucial implications for enhancing user experiences, fostering customer loyalty, and fully unlocking the potential for value creation among customers.

Appendix 4.1 Measurement items

Constructs	Indicators	Resource
Help	HP1: I assist others if they need my help with this platform.	Garrouch and Ghali (2023)
	HP2: I help other users if they encounter difficulties with this platform.	
	HP3: I provide guidance to other users regarding this platform.	
	HP4: I would teach others how to use this platform correctly.	
Feedback	FE1: If I have a useful idea to improve this platform, I share it with its managers.	
	FE2: If I receive excellent service or products from this platform, I leave feedback	
	FE3: If surveyed by this platform, I willingly provide feedback and information.	
Tolerance	TE1: If this platform doesn't function as expected, I am willing to tolerate it.	
	TE2: If this platform makes an error in processing transactions, I am willing to be patient.	
	TE3: If I have to wait longer than anticipated for a transaction to complete, I am willing to adapt.	
Advocacy	AY1: I recommend this platform to others.	
	AY2: I encourage friends and relatives to use this platform.	
	AY3: I speak positively about this platform to others.	
Functional value	FV1: Playing games on this platform enhances my financial literacy and understanding.	Yu and Huang (2022)
	FV2: Playing games on this platform provides me with practical insights on managing personal finances.	
	FV3: Playing games on this platform is beneficial in terms of financial education, entertainment, and social interaction.	
	FV4: Gamification on this platform has positively influenced my financial decision-making and planning.	

Constructs	Indicators	Resource
Social value	SV1: Games on this platform are popular among people around me.	Yu and Huang (2022)
	SV2: I am influenced by others to play games on this platform.	
	SV3: My relatives and friends hold a favorable attitude towards games on this platform	
	SV4: I think using mobile payment apps will help improve my social image	
Emotional value	EV1: Playing games on this platform brings joy	Yu and Huang (2022)
	EV2: Playing games on this platform can provide a sense of relaxation	
	EV3: Playing games on this platform is enjoyable.	
	EV4: Playing games on this platform makes me feel good.	
Monetary value	MV1: Game rewards can be traded for cash.	Yoon et al (2013)
	MV2: Game rewards have high trading value.	
	MV3: Many users participate in game reward trading.	
	MV4: Profit can be earned from game reward trading.	
Satisfaction	S1: I am satisfied with the microfinance service provided by this platform.	Chung et al. (2020)
	S2: The microfinance service provided by this platform has performed well.	
	S3: The microfinance service provided by this platform met my expectations.	
	S4: I am happy using the microfinance service provided by this platform.	

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Chapter 5. Findings, discussion and conclusions

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Microfinance plays a key role in fighting against financial exclusion and promoting entrepreneurship in developing countries (Annim, 2012; Bassem, 2008). During the last decade, microfinance providers also greatly benefited from the advent of ICT applications, especially customer-related technologies focused on by this paper. These ICT tools and strategies can help microfinance providers improve efficiency, reduce costs, and alter the way individuals access financial services (Moro-Visconti, 2021). Despite the significance of ICTs in the development of the microfinance industry, few studies have provided a whole picture of the relationship between microfinance and ICTs.

Besides, the emerging microfinance platforms based on ICTs have been updating their functions and services by introducing a series of digitalization strategies. However, they must take customers' needs into consideration to provide efficient and effective financial services. Therefore, it is necessary to analyze whether and how ICTs can be promoted from the customer's perspective.

In the second chapter, our analysis of scientific output in microfinance and ICT from 1998 to 2020 revealed several key findings. Firstly, there was a noticeable increase in annual publications and citations, particularly after 2006, possibly due to Muhammad Yunus receiving the Nobel Peace Prize and rapid technological advancements. Secondly, top research institutions included the National University of Singapore and Tsinghua University, with active countries being the United States, China, France, and Singapore. Thirdly, notable journals like Electronic Commerce Research and Applications were identified, along with influential publications and authors such as Bruton et al. (2015), Stephen and Galak (2012), and Allison et al. (2015).

A key finding is that ICT-based crowdfunding and P2P lending platforms have been the major topics of this research field. In addition, there has been a spate of research interest in the role of these online microfinance platforms in entrepreneurship.

To further illustrate the impact of ICTs on the microfinance industry, we have analyzed the links between "technology" and "microfinance" shown in the timeline view. Research

corresponding to these connections, on the one hand, examined the impact of ICTs on various aspects of microfinance, including impacts on operations, efficiency, performance, sustainability, outreach, etc. On the other hand, some of these works explored the factors influencing the adoption of ICTs in microfinance.

Based on the above findings, we conclude that studies on microfinance and ICT use can be divided into two categories. First, from the macro level, many studies explored the relationship between ICTs and the microfinance industry directly. Another category is analyzing the specific application of ICTs in the microfinance industry—ICT-based crowdfunding and P2P lending platforms, including how they work, their revolution and risks, their relationship with entrepreneurship, etc. It is expected that ICTs and ICT-based platforms will continue to play a role in the future development of microfinance and even the entire finance industry. Subsequently, more and more academic attention will be put on this subject.

At last, we proposed that research on applying fintech, especially blockchain technology and other emerging technologies, to promote financial inclusion is one of the future research trends. Furthermore, much of the recent literature pays particular attention to financial inclusion and entrepreneurship domains (Nogueira et al., 2020). Given that the role of financial inclusion in poverty alleviation and economic development has been worldwide recognized, more empirical research is needed to determine whether and how financial inclusion influences entrepreneurship. Besides, exploring more channels to realize the positive impact of financial inclusion on entrepreneurship will be interesting.

Following this, Chapters 3 and 4 delved into customers' attitudes and usage intentions towards ICTs in China's microfinance platforms, with a specific emphasis on FRT and gamification strategies. Specifically, chapter three provides a deeper insight into users' resistance behaviors toward FRT on microfinance platforms by integrating the technology paradox framework (Jarvenpaa & Lang, 2005; Mick & Fournier, 1998) and self-efficacy theory (Compeau & Higgins, 1995). Our findings revealed that the antecedents—self-efficacy, technology paradoxes, and anxiety—were all related to usage intention toward

FRT. In particular, we demonstrated two primary technology paradoxes related to FRT usage—efficiency/inefficiency and private/public.

Besides, we found that self-efficacy significantly influences technology paradoxes, anxiety, as well as resistance. These findings supported the social cognitive theory (Compeau & Higgins, 1995), which was consistent with previous research on how self-efficacy affects users' anxiety (Cazan et al., 2016) and usage intention for FRT (Li et al., 2020; Moriuchi, 2021). Additionally, while satisfiers of the technology paradox (efficiency and private) did not significantly correlate with anxiety, dissatisfiers (inefficiency and private) exhibited positive correlations, in line with existing studies (Bulmer et al., 2018; Wilson-Nash & Tinson, 2021). It shows that customers of the microfinance platforms are more concerned about the inefficiency of FRT usage and the leakage of personal information, which can invoke their negative feelings. Lastly, a positive correlation was found between anxiety and resistance, consistent with prior theories and research (Ekizoglu & Ozcinar, 2010; Lu & Su, 2009; McFarland & Hamilton, 2006; Meuter et al., 2003).

Another study included in Chapter 4 investigates how customer value from gamification influences customer satisfaction with microfinance platforms and subsequently shapes customer citizenship behaviors. We found that both functional value (FV) and social value (SV) significantly impact satisfaction, consistent with previous research emphasizing utilitarian and social aspects (Evelina et al., 2020; Furukawa et al., 2019). Moreover, satisfaction not only positively drives helping, feedback, tolerance, and advocacy, but also mediates the relationship between FV, SV, and customer citizenship behaviors. These findings highlight the pivotal role satisfaction plays in fostering customer engagement and loyalty. However, the relationships between EV, MV, and satisfaction were not found to be significant, which is inconsistent with previous research (Deng et al., 2010; Slack et al., 2020). This may suggest that, in the specific context of the study, customers' assessments of emotional and monetary aspects have a limited impact on their overall satisfaction.

This dissertation contributes to a deeper understanding of the dynamics between microfinance and ICTs and offers practical implications for policymakers, practitioners, and researchers in the field. Firstly, despite the significance of ICTs in the development of the

microfinance industry, few studies have provided a whole picture of the relationship between microfinance and ICTs. Although bibliometric methods have been introduced to the microfinance field recently, this paper is the first to address issues from the perspective of ICTs. By providing a comprehensive review of ICT-related research in the field of microfinance, this study provides researchers and practitioners with important insights into the role of ICTs in microfinance and even the entire financial industry.

Secondly, this study empirically explains the underlying mechanisms of user resistance to FRT usage. It helps microfinance providers understand the paradoxes faced by FRT users and take appropriate actions. While efficiency and profitability are crucial for microfinance in a competitive environment, providers must also consider customers' perceptions of efficiency. Moreover, concerns regarding data leakage among customers impede the adoption of FRT, even in the presence of privacy regulations. To address this, microfinance platforms and governments should improve transparency and give users control over their data.

Thirdly, the present study expanded the technology paradox framework by introducing the self-efficacy theory. It highlighted the significance of psychological factors (e.g., self-efficacy, anxiety) in affecting users' adoption decisions. To build customers' confidence and ease their anxiety, microfinance providers need to increase the frequency of FRT use through rewards and other ways and provide users with the necessary education and training to encourage them to use FRT.

Fourthly, this study adds to the existing body of knowledge by delving into the diverse customer value from gamification strategies within the microfinance sector. Besides, our study widens the research scope of CCB by identifying the antecedents of CCB in the gamified microfinance platform settings. Our empirical findings not only substantiate the strategic integration of gamified elements into microfinance platforms but also offer practical insights for enhancing customer loyalty and creating additional value from customers through maintaining customer relationships.

Finally, technology designers can benefit from this research by getting a better

understanding of users' needs, thereby improving ICT performance and promoting their usage. To enhance the effectiveness of ICTs, they should take into consideration various elements influencing ICT adoption, such as efficiency, privacy, self-efficacy, entertainment, and economy. For example, this study suggests that technology designers should make a trade-off between efficiency and privacy. It encourages designers to take both system functionality and its impacts on users' privacy into consideration.

By addressing the challenges and harnessing the opportunities presented by technological advancements, we can further advance financial inclusion efforts and empower underserved individuals and communities. These insights provide crucial implications for enhancing user experiences, fostering customer loyalty, and fully unlocking the potential for value creation among customers.

Chapter 6. Limitations and further research

Chapter 6. Limitations and further research

While this study makes significant contributions to understanding the role of ICTs in microfinance, several limitations must be acknowledged. Firstly, the empirical analyses primarily focused on the Chinese microfinance context. Although this provides valuable insights into a significant market, the findings may not be directly generalizable to other regions with different socio-economic and cultural backgrounds. Future research should aim to conduct comparative studies across different countries and regions to examine how cultural, regulatory, and economic differences impact the adoption and effectiveness of ICTs in microfinance. This would help in identifying context-specific factors and best practices that can be generalized or adapted across different settings.

Secondly, the sample size, while adequate for the scope of this study, could be expanded in future research to enhance the robustness of the findings.

Thirdly, the bibliometric analysis covered publications from 1998 to 2021. While this timeframe captures a substantial body of literature, it may miss more recent developments and emerging trends in ICT and microfinance post-2021.

Fourthly, the study's focus on specific ICT tools such as FRT and gamification strategies might limit the generalizability of the findings to other types of technologies used in the microfinance sector. Thus, expanding the scope to include a wider variety of ICT tools and digital strategies beyond FRT and gamification could provide a more comprehensive understanding of how different technologies impact microfinance operations and client experiences. Technologies such as blockchain, artificial intelligence, and big data analytics warrant further exploration.

Fifthly, as our study offers a snapshot of customer experiences, future research could adopt a longitudinal approach to track the evolution of customer preferences and behaviors over time. This approach could capture trends and shifts in user behavior, technology adoption, and the overall effectiveness of microfinance services.

Finally, the reliance on quantitative methods such as bibliometric analysis and structural

equation modeling (SEM) may overlook qualitative nuances that are equally important in understanding the complex dynamics between ICTs and microfinance. Therefore, incorporating qualitative research methods, such as case studies, interviews, and focus groups, could provide deeper insights into the experiences and perceptions of microfinance clients and providers. This would complement the quantitative findings and offer a richer understanding of the human factors influencing ICT adoption.

Apart from the above future research directions, future works could be done to explore the broader impact of ICTs on financial inclusion, particularly how these technologies can bridge gaps for underserved populations. This includes examining the effectiveness of ICTs in reaching marginalized groups and improving their access to financial services. Moreover, investigating the role of policy and regulatory frameworks in shaping the adoption and implementation of ICTs in microfinance is crucial. Future research could analyze how different regulatory environments either facilitate or hinder the integration of digital technologies in the sector. Furthermore, research should delve into user-centric design principles for ICTs in microfinance. Understanding user needs, preferences, and pain points can help in designing more effective and user-friendly technologies that enhance customer satisfaction and engagement.

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ANNEX

Annex 3.1 Measurement items

Construct	Questionnaire Items	Adapted from
Efficiency	EF1. Using the facial recognition function of microfinance platforms improves my efficiency. EF2. Using the facial recognition function of microfinance platforms enables me to access the microfinance platforms faster. EF3. Most of the time, using the facial recognition function of microfinance platforms is convenient to use.	Garrity (2012); Park and Zhang (2021)
Inefficiency	IE1. Figuring out how to use the facial recognition function of microfinance platforms is usually too time-consuming. IE2. Using the facial recognition function of microfinance platforms always seems to take longer than I expected. IE3. Using the facial recognition function of microfinance platforms is often more complicated than needs to be.	Garrity (2012); Park and Zhang (2021)
Private	PR1. If I use the facial recognition function of microfinance platforms, I believe that how these platforms use my personal information is in my control. PR2. If I use the facial recognition function of microfinance platforms, I believe that what personal information is released by microfinance platforms is in my control. PR3. If I use the facial recognition function of microfinance platforms, I believe that I can control my personal information provided to the microfinance platforms.	Liu et al. (2021); Xu et al. (2008)
Public	PU1. Using the facial recognition function of microfinance platforms makes me worried about the amount of personal information acquired by microfinance platforms. PU2. Using the facial recognition function of microfinance platforms makes me worried that my personal data might be accessed by unauthorized persons. PU3. Using the facial recognition function of microfinance platforms makes me worried that my personal data might be misused by microfinance platforms.	Liu et al. (2021); Xu et al. (2008)
Resistance	R1. I am reluctant to utilize the facial recognition function of microfinance platforms. R2. I insist on using passwords rather than the facial recognition function of microfinance platforms. R3. I would not recommend the facial recognition function of microfinance platforms to others.	Liu et al. (2021); Kang and Kim (2009); Lee (2020);
Self-efficacy	SE1. I am sure that I have the ability to overcome difficulties brought by the facial recognition function of microfinance platforms. SE2. Compared with others, I have the confidence to conduct any type of transaction through face recognition and any other authorization method. SE3. I have the confidence to overcome certain difficult financial transactions due to the use of the facial recognition function of microfinance platforms.	Moriuchi (2021)
Anxiety	A1. It makes me nervous to think about losing personal information due to incorrect use of the facial recognition function of microfinance platforms. A2. I am hesitant to use the facial recognition function of microfinance platforms because I'm afraid of making mistakes that I can't correct. A3. I fear that mistakes brought by the facial recognition function of microfinance platforms are potentially devastating.	Patil et al. (2020) Rana et al. (2017); Lu and Su (2009); Johnson et al. (2008)

Annex 4.1 Measurement items

Constructs	Indicators	Resource
Help	HP1: I assist others if they need my help with this platform.	Garrouch and Ghali (2023)
	HP2: I help other users if they encounter difficulties with this platform.	
	HP3: I provide guidance to other users regarding this platform.	
	HP4: I would teach others how to use this platform correctly.	
Feedback	FE1: If I have a useful idea to improve this platform, I share it with its managers.	
	FE2: If I receive excellent service or products from this platform, I leave feedback	
	FE3: If surveyed by this platform, I willingly provide feedback and information.	
Tolerance	TE1: If this platform doesn't function as expected, I am willing to tolerate it.	
	TE2: If this platform makes an error in processing transactions, I am willing to be patient.	
	TE3: If I have to wait longer than anticipated for a transaction to complete, I am willing to adapt.	
Advocacy	AY1: I recommend this platform to others.	
	AY2: I encourage friends and relatives to use this platform.	
	AY3: I speak positively about this platform to others.	
Functional value	FV1: Playing games on this platform enhances my financial literacy and understanding.	Yu and Huang (2022)
	FV2: Playing games on this platform provides me with practical insights on managing personal finances.	
	FV3: Playing games on this platform is beneficial in terms of financial education, entertainment, and social interaction.	
	FV4: Gamification on this platform has positively influenced my financial decision-making and planning.	
Social value	SV1: Games on this platform are popular among people around me.	Yu and Huang (2022)
	SV2: I am influenced by others to play games on this platform.	
	SV3: My relatives and friends hold a favorable attitude towards games on this platform	
	SV4: I think using mobile payment apps will help improve my social image	
Emotional value	EV1: Playing games on this platform brings joy	Yu and Huang (2022)
	EV2: Playing games on this platform can provide a sense of relaxation	
	EV3: Playing games on this platform is enjoyable.	
	EV4: Playing games on this platform makes me feel good.	
Monetary value	MV1: Game rewards can be traded for cash.	Yoon et al (2013)
	MV2: Game rewards have high trading value.	
	MV3: Many users participate in game reward trading.	
	MV4: Profit can be earned from game reward trading.	
Satisfaction	S1: I am satisfied with the microfinance service provided by this platform.	Chung et al. (2020)
	S2: The microfinance service provided by this platform has performed well.	

Constructs	Indicators	Resource
	S3: The microfinance service provided by this platform met my expectations.	
	S4: I am happy using the microfinance service provided by this platform.	