

A Study on Legal Safeguards and Risk Control in FinTech Regulatory Sandboxes

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Abstract: This paper discusses the legal safeguards and risk control strategies in FinTech regulatory sandboxes. By analyzing the practice of international regulatory sandboxes and combining it with the actual situation in China, it proposes a set of legal safeguards framework and risk control system of regulatory sandboxes suitable for China's national conditions, aiming at balancing the relationship between FinTech innovation and financial stability and promoting the healthy development of FinTech. The study centers on exploring how to carry out FinTech innovation in a controlled environment, ensuring consumer protection and data privacy, preventing systemic financial risks, and promoting international regulatory coordination.

Keywords: FinTech; regulatory sandbox; legal safeguards; risk control

1. Introduction

1.1 Background of the Study

FinTech has been developing rapidly in recent years, bringing innovative impetus to the traditional financial industry as well as new regulatory challenges. In order to cope with the regulatory needs brought by FinTech innovation, the regulatory sandbox mechanism has been gradually adopted by various countries. Regulatory sandbox refers to a controlled testing environment provided by financial regulators for FinTech companies or other innovative enterprises. In this environment, companies can test new products, services or business models under real market conditions, while setting certain conditions and restrictions under the supervision of the regulator in order to innovate within controlled risks. China has been piloting regulatory sandboxes in a number of cities since December 2019, drawing on international experience and exploring regulatory mechanisms that meet local needs. The implementation of the FinTech regulatory sandbox involves the underlying framework of financial law, consumer protection law, data privacy law and other aspects of legal protection. In the sandbox environment, regulators need to balance innovation and risk management to ensure the safety and stability of the financial system.

1.2 Research Methods

This method involves analyzing existing literature, policies, regulations, and case studies to gain an in-depth understanding of the legal framework, operational mechanisms, and risk control methods in the financial technology regulatory sandbox. It includes reviewing both domestic and international research progress, summarizing the experiences of regulatory sandboxes in various countries, and identifying their successes and shortcomings.

1.2.1 Comparative Analysis

This approach selects representative countries or regions (e.g., the United Kingdom, Singapore) for comparative analysis of regulatory sandbox models. It examines the similarities and differences in legal protection and risk control strategies, identifying advanced practices that can inform improvements in China's FinTech regulation.

1.2.2 Legal Norms Analysis

This method evaluates current FinTech regulations to identify the need for legal safeguards and the gaps in existing laws. It assesses the effectiveness of existing regulations in mitigating financial technology risks and provides recommendations for legal improvements.

1.2.3 Game Theory Analysis

This method uses game theory to analyze the interactions and decision-making behaviors of key stakeholders (e.g., regulators, FinTech companies, consumers) to explore strategies and mechanisms that optimize regulatory outcomes.

2. Literature Review

In recent years, the rapid development of FinTech has challenged traditional financial regulation. To balance innovation and risk, regulators worldwide have introduced regulatory sandbox mechanisms to foster innovation while ensuring stability and consumer protection. This paper aims to study the legal protection and risk control of FinTech regulatory sandboxes. Before this, a systematic review of relevant domestic and international literature is necessary to identify existing research findings and gaps, laying the foundation for this study.

2.1 Meaning and characteristics of financial technology

FinTech uses advanced digital technologies like big data, AI, and blockchain to improve financial services. According to the World Economic Forum (2015), FinTech is technology-driven innovation creating new business models, applications, processes, or products[1]. It is characterized by technology-driven, cross-border integration, and enhanced efficiency, breaking industry barriers and meeting diverse consumer needs.

2.2 Meaning of sandbox regulation and analysis of the current situation

The term “regulatory sandbox” (regulatory sandbox) first appeared in the UK Government Office for Science in March 2015 in a report, referring to the financial regulator based on financial technology innovation purposes, in a certain space and time frame to authorize and license some financial institutions or enterprises to test innovative financial products, financial models, financial business, and to ensure that the financial services industry is able to meet the needs of consumers. financial products, financial models, and financial businesses, and to discontinue or promote them based on the conclusions of their tests. The regulation, through the exercise of exemptions from the rules, cracks the dilemma of non-compliance faced by innovative finance in practice, and corrects the risks embedded in innovative finance while ensuring that the innovative behavior will not face the corresponding legal consequences in the “sandbox”. The concept of “regulation” has been widely recognized by the theoretical community since it was first proposed, and it is believed that if some kind of regulation needs to be created through legislation to address the changes and challenges brought about by technology-based finance, “sandbox regulation” is the best measure to solve the above problems (Li & Li, 2021)[2]. Academic research on “sandbox regulation” mainly focuses on the concept of the system and the positioning of the regulatory body (Zhao J 2017) [3]. With the expansion of the influence of this system, more and more scholars began to pay attention to its characteristics, such as the relationship between the regulator and the regulated shifted from antagonism to cooperation (Liu Sheng, 2021)[4], and the way of regulation changed from static to dynamic (Ling, Long, & Zhao, Xu, 2021)[5]. Shen Wei and Zhang Yan believe that “sandbox regulation” can improve the many shortcomings of traditional financial regulation, and actively carry out research on the localization and adaptation of this system in China and its development path.

The core features of regulatory sandbox mainly include the following aspects: firstly, it provides a controlled environment for testing under limited conditions, which makes the risk controllable; secondly, regulatory sandbox gives certain regulatory exemptions or relaxation to the participants, which allows the participants not to fully follow the existing regulatory system during the sandbox period; and lastly, it emphasizes on the close communication and timely feedback between the regulators and the participants in order to promote the healthy development of financial innovation. Together, these features form the basis of the regulatory sandbox, which aims to balance financial innovation with risk prevention and control, and provide support for the development of FinTech.

Major countries like the UK, Singapore, and Australia have actively explored and implemented regulatory sandboxes in FinTech. The UK, as the birthplace of sandboxes, has run multiple successful batches of its FCA sandbox program, promoting financial innovation and competition. Singapore's MAS launched its sandbox in 2016 to attract global FinTech firms and strengthen its financial hub status. Australia's ASIC also established a sandbox with clear participation criteria and risk management measures to ensure compliance. Common elements include flexible regulatory frameworks, clear participation guidelines, and risk mitigation strategies, which foster innovation while protecting consumers. These practices offer valuable insights for global FinTech regulation.

Since 2019, the People's Bank of China and other regulatory bodies have launched financial technology innovation regulatory pilot programs in cities such as Beijing, Shanghai, and Shenzhen, which represent China's version of a regulatory sandbox. These pilots cover multiple areas, including payment settlement, credit services, and robo-advisory. In academic research, domestic scholars have primarily focused on exploring regulatory models, analyzing the characteristics of China's regulatory sandbox, and comparing it with international experiences. Studies have examined the development of foreign regulatory sandboxes and their implementation paths in China's technology sector, provided a global technological and economic outlook, and conducted legal protection analyses. They have also discussed the legality and feasibility of regulatory sandboxes within China's legal framework, explored the construction of a legal system for China's regulatory sandbox, and

engaged in financial regulatory research and risk control studies to identify potential risks of regulatory sandboxes and propose corresponding control measures. Additionally, there have been explorations of the regulatory sandbox system and its practical applications. These studies have offered theoretical support and practical guidance for a deeper understanding and effective implementation of the regulatory sandbox.

Overall, existing studies mostly affirm the theoretical value of the system but provide insufficient exploration of its limitations and necessary legal improvements. While highlighting the institutional value and necessity, practical challenges of "sandbox regulation"—such as rent-seeking, questionable experimental results, and limited innovation space—should be addressed. Ignoring these could hinder China in adopting "sandbox regulation" and other FinTech regulatory frameworks. Therefore, it is essential to clarify their positive impacts and, at the same time, deeply analyze their shortcomings and explore legal improvements, which is crucial for promoting FinTech innovation and ensuring financial law evolves with the times.

2.3 Game Analysis of Financial Regulation and FinTech Innovation

Western countries have taken the lead in the theoretical study of financial innovation and regulation. Some scholars have pointed out that financial innovation is mainly divided into two categories: one is innovation to avoid regulation, and the other is a priori innovation unrelated to regulation. Some scholars emphasize that regulation is the main driver of financial innovation, and that there is a dynamic evolutionary game process between financial innovation and regulation, which aims to gain more profits by avoiding regulation. Therefore, regulation should be viewed as an optimal mechanism design problem that balances innovation and risk through sound regulatory policies, while over-regulation may weaken the incentives of financial institutions to innovate. After the financial crisis, there is a scarcity of literature directly studying the regulation of financial innovation, with studies focusing more on rethinking microprudential-based regulatory strategies and exploring how to prevent systemic financial risks through a macroprudential regulatory framework.

Some domestic literatures take FinTech enterprises and government regulators as research objects, construct a dynamic game model, and analyze the steady state conditions of both sides in detail. Based on the assumption of "limited rationality", some scholars have constructed an evolutionary dynamic game model between Internet financial enterprises and regulators, and explored the issue of "appropriateness" of Internet financial regulation (Zhang Chenghu and Liu Jie, 2020)[6]. Lv Shoujun and Xu Haixia (2017) use evolutionary game theory to dynamically analyze the adjustment process of financial innovation and financial regulation, and take the innovation and regulation of the P2P industry as an example to study how to design the financial regulatory system through incentive measures[7]. Song Yang et al. (2018) analyzed the repeated game process of the equilibrium path of "regulation, violation (compliance) innovation, and fine (regulation)" between Internet financial enterprises and regulators, and proposed that when the innovation level of Internet finance and the regulatory strength reach a critical value, the two sides may achieve a "win-win" situation[8]. The "win-win" situation may be realized by both sides when the innovation level of Internet finance and the intensity of regulation reach a critical value. Xu Wenbin et al. (2019) studied the evolutionary path of financial regulation and financial innovation based on the idea of evolutionary economics and the dynamics method, and concluded that the regulator's mastery of the market dynamics and the implementation of predictable regulatory policies are the key to achieving the regulatory objectives[9].

2.4 Interaction Model and Theoretical Framework of FinTech and Regulatory Sandbox

2.4.1 Theoretical Foundations of Regulatory Sandbox

The construction of regulatory sandboxes is grounded in three core theories:

Regulatory Arbitrage Theory: Utilizing controlled testing environments to prevent excessive circumvention of regulatory frameworks by enterprises; Rogers' Innovation Diffusion Theory: Accelerating the adoption of technological applications and validation of business models; Triple Helix Model: Fostering a dynamic innovation ecosystem through collaboration among governments, enterprises, and academic institutions. These theories collectively address the inherent tension between financial innovation and systemic stability.

2.4.2 Models of Interaction Mechanism between FinTech and Regulatory Sandbox

The interaction mechanism between FinTech and regulatory sandbox can be described by some classic models, such as the innovation life cycle model and the double helix interaction model. The innovation lifecycle model describes the whole process of FinTech innovation from germination to maturity, in which the regulatory sandbox plays a key supportive role to help FinTechs transition smoothly from the proof-of-concept stage to commercialized applications. The entire process includes phases of proof of concept, prototype development, small-scale testing, and full-market adoption, with the regulatory sandbox playing the role of risk management and compliance guidance at each stage, enabling innovations to be validated in a controlled environment. The double helix interaction model, on the other hand, compares FinTech companies and regulators to two spirals, with continuous innovation in FinTech driving changes in regulatory policy, which dynamically

adapts to accommodate and encourage the application of new technologies. This two-way evolutionary model emphasizes the interaction between FinTech and regulation, i.e. FinTech drives regulatory change while new regulatory policies in turn influence the direction of FinTech innovation.

2.4.3 Game and Synergy Mechanisms of FinTech Innovation in the Regulatory Sandbox

In game theory, a game consists of participants (players), strategies, and payoffs. In the game between FinTech companies (innovators) and regulators, the key decision for FinTech firms is whether to pursue "high innovation" or "low innovation." High innovation can yield greater market share and competitive advantage but may involve circumventing regulations, resulting in legal risks, fines, or reputational damage. Low innovation ensures compliance but may miss market opportunities and technological progress. Regulators, on the other hand, choose between "lax" or "strict" regulation. Lax regulation fosters industry growth and innovation but may risk market failure or inadequate consumer protection, while strict regulation ensures stability but could stifle innovation. Regulators also decide whether to be "cooperative" or "uncooperative." In a cooperative approach, they work with FinTechs to understand innovation needs and create appropriate regulatory sandboxes, whereas non-cooperation means restricting FinTech innovation.

In terms of payoffs, FinTechs earn from market share, successful product innovation, and potential legal risks (e.g., fines or reputational losses), while regulators benefit from consumer protection, market stability, data privacy, and legal risk management. The relationship between FinTech innovation and regulatory sandboxes involves both cooperation and competitive dynamics. From a game theory perspective, regulators focus on system stability and consumer protection, while FinTech firms pursue innovation and profit. In the regulatory sandbox, both sides seek balance through negotiation and feedback, ensuring innovation progresses while maintaining effective regulation and financial system safety. Game theory reveals the interaction between innovation and compliance, helping identify an optimal balance between both players.

3. Comparative Study of Cross-border Practices of Regulatory Sandbox

The Financial Conduct Authority (FCA) of the United Kingdom, as the pioneer of the global regulatory sandbox system, established a dual-track mechanism of "test authorization + temporary exemption" in 2016. According to its sixth evaluation report, 58% of the selected firms are FinTech startups, and the cumulative 187 temporary exemptions (up to 2023) have reduced compliance costs by 34%, but the 3-year survival rate of the tested firms (79%) is 12 percentage points lower than the industry average over the same period (FCA, 2023)[10]. The Monetary Authority of Singapore (MAS) has built an agile review framework through a cross-departmental technical advisory committee (comprising academic institutions and industry experts), and its joint sandbox with the FCA has landed nine cross-border projects and attracted S\$5.1bn of funding based on its annual FinTech Festival Monetary Authority of Singapore. (MAS, 2021)[11]. The Australian Securities and Investments Commission (ASIC) has set quantitative entry criteria through section 7.6.02A of the Corporations Act (≤ 100 clients/funds \leq A\$5 million) and requires firms to have a minimum of A\$2 million professional liability insurance to mitigate risk (ASIC, 2022)[12].

China accepted 126 innovative projects during the pilot period (2019–2021), of which 41% were in the digital payments category, but only 30% of local regulators had professional assessment capabilities (PBOC, 2021)[13]. The average cost of cross-border data compliance accounts for 15-25% of the digitalization project budget for enterprises, highlighting the institutional contradiction between experimental authorization and the legal retention principle (China Cross-Border Data Flow Regulation White Paper, 2022)[14]. Comparative studies show significant differences in regulatory paradigms across countries: the UK activates market effectiveness with flexible exemptions, Singapore relies on technological governance to facilitate cross-border collaboration, Australia legislates for clear thresholds for risk quantification, and China urgently needs to balance tolerance for innovation with the adaptation of a rule of law framework.

4. Legal Issues Faced in the Regulatory Sandbox

The regulatory sandbox faces many legal issues in the implementation process. First, insufficient legal applicability, the existing legal system is difficult to cover the innovative business and technical means of FinTech, which makes it difficult for regulators to clarify its compliance requirements. Secondly, data protection and privacy issues are prominent. The flexibility of sandbox testing has led to increased data mobility, and data is shared or transmitted between different platforms and organizations, increasing the risk of leakage, while companies need to seek a balance between innovation and data compliance. Furthermore, risk liability and consumer protection are insufficient. Innovative products in the sandbox have not been fully verified by the market, and there is uncertainty, and the current law has vague provisions on liability, and consumer rights and interests protection mechanisms are missing. In addition, the issue of regulatory authority and cooperation is also more prominent. The sandbox involves multiple regulatory agencies, and the responsibilities and authority of each agency has its

focus, but innovative products straddle the traditional financial field, which may easily lead to unclear, overlapping or gaps in regulatory authority. The balance between innovation and compliance is also a major challenge, as traditional regulations are difficult to adapt to new technologies and business models, but over-regulation or leniency may lead to risks. The protection of intellectual property rights should not be ignored, as the involvement of multiple parties in testing can lead to ambiguous attribution and increased risks of information leakage and infringement. Finally, cross-border compliance is a challenge. The cross-border nature of FinTech makes it necessary for the sandbox mechanism to cope with the conflicts and adaptability of laws and regulations in different countries, and cross-border data flow and financial innovation are restricted, so international cooperation and standardization are needed to promote global rollout.

5. Solutions for Regulatory Sandbox

In order to address the key challenges in the implementation of regulatory sandboxes, it is necessary to build a multi-dimensional and collaborative governance mechanism. On the legal level, establish a dedicated FinTech regulatory framework and dynamically revise the law, incentivize innovation through flexible legislative mechanisms, policy exemptions, and synchronize risk assessment and localization of international experience; implement express authorization and mandatory encryption technology for data governance, standardize the management of the entire life cycle of data, and strengthen compliance audits to adapt to the Cybersecurity Law and the Personal Information Protection Law. In terms of risk prevention and control, we have clarified the boundaries of corporate-regulatory-consumer responsibilities, established a protection fund and a rapid mediation mechanism, and supplemented it with third-party dynamic monitoring; cross-sectoral collaboration through the establishment of a joint coordinating committee and an information-sharing platform has eliminated regulatory overlaps, and promoted institutionalized cooperation processes. The balance between innovation and compliance relies on a phased risk assessment and early warning intervention mechanism, strengthened two-way communication between regulators and enterprises and dynamic updating of laws, embedded compliance design and strengthened risk disclosure. Intellectual property protection should be centered on attribution agreements, confidentiality clauses and expedited arbitration, limiting the scope of technology disclosure and raising awareness of protection. Cross-border compliance rules should be constructed through international organizations to build a multilateral framework, unify anti-money laundering and data rules, conduct research on legal compliance and promote mutual recognition of standards, and form a cross-border regulatory template based on the Libra case. To sum up, the regulatory sandbox needs to take legal flexibility, data refinement, responsibility clarification and international standardization as the core path to achieve a balance between innovation incentives and risk prevention and control through a dynamic adaptive regulatory system.

6. Future Development Trends of FinTech Regulatory Sandbox

The future FinTech regulatory sandbox will evolve in multiple dimensions. It will create a layered regulatory framework with a simplified sandbox for startups and a complex one for mature enterprises to enhance risk control, fostering innovation throughout its lifecycle. Cross-border synergies will be deepened by establishing a global sandbox network through institutions like the IMF and FSB, resolving cross-border payment compliance challenges through bilateral agreements (e.g., the Libra case), and reducing internationalization costs. Technologically, big data and AI will enable dynamic regulation and real-time risk monitoring, while the introduction of a "privacy sandbox" will test encryption and data governance solutions. The sandbox will adopt progressive compliance strategies, with "technology sandboxes" for emerging technologies like blockchain. Focus on green finance will enhance transparency through blockchain and integrate ESG indicators to support carbon neutrality. The study suggests that regulatory sandboxes must balance risk and innovation through layered regulation, technology, and cross-border collaboration, and emphasizes improving data protection, establishing specialized technology sandboxes, and strengthening green finance frameworks for global and sustainable development.

7. Conclusion

This study centers on the legal framework and risk control mechanism of FinTech regulatory sandbox, combines domestic and international practical experience, and applies game theory analysis to study the game relationship between FinTech innovation and regulation. The study finds that the legal framework of the FinTech regulatory sandbox is still under continuous improvement, and there are challenges especially in the areas of data protection, risk liability and cross-border compliance. Foreign experience shows that sound legal protection and adaptive risk control measures are the key to the effective operation of regulatory sandboxes, while the country still faces legal gaps in these aspects, and there is an urgent need to strengthen the effectiveness of regulatory sandboxes through policy innovation and legal system construction. From the perspective of game theory, the interaction between FinTech enterprises and regulators in the sandbox presents a game

between innovation and risk control, and appropriate incentives and regulatory strategies can balance innovation and risk prevention and control, and promote technological innovation while effectively preventing financial risks. Through the comparison of regulatory sandboxes at home and abroad, the study shows that although there are differences in the legal and operational levels among countries, they all emphasize the equal importance of risk control and innovation. Combined with international experience, China can draw on practices such as progressive regulation and cross-border cooperation to meet the complex challenges posed by the rapidly developing FinTech industry. To address the legal applicability and data privacy protection issues that China is currently facing, this study puts forward policy recommendations such as strengthening legal safeguards, improving data protection mechanisms and exploring flexible cross-border compliance paths.

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