

Research on Big Data Promoting the Construction of Credit Risk Prevention and Control System for Sichuan Commercial Banks

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ABSTRACT

This study examines the application of big data technology in risk management for commercial banks in Sichuan Province. Through literature review and case analysis, it reveals that while progress has been made in risk control infrastructure, challenges persist including an incomplete credit system, delayed information processing, prominent data silos, and low staff competency. Recent regulatory penalties—including a 4.8 million yuan fine imposed on a joint-stock commercial bank's Chengdu branch for systematic violations and a 7.28 million yuan penalty against a provincial-level city commercial bank in early 2026—highlight systemic deficiencies in compliance management and risk control frameworks. By establishing multidimensional data foundations, automating approval processes with intelligent early warnings, implementing tiered response mechanisms across workflows, and enhancing system integration and standardization, big data technology can drive a transition from "experience-driven" to "data intelligence-powered" risk management. Accordingly, recommendations are proposed in five key areas: strengthening data governance, improving risk mechanisms, upgrading staff capabilities, building collaborative ecosystems, and reinforcing regulatory guidance, with the understanding that under unified regulatory standards, different implementation strategies should be adopted based on each bank's specific circumstances. This provides theoretical and practical guidance for constructing an intelligent risk control system.

KEYWORDS

Big data; Commercial banks; Risk prevention and control; Sichuan province; Intelligent transformation

1 Introduction

Finance is the cornerstone of the modern economy, with preventing systemic risks as the fundamental mission of financial institutions^[1-3]. In recent years, Chinese commercial banks have faced increasingly complex risk landscapes, with credit, market, operational, and liquidity risks intertwining—posing significant challenges to traditional risk management frameworks. Meanwhile, next-generation information technologies represented by big data and AI are reshaping the financial industry^[4-7]. Big data technology is transforming risk prevention logic: shifting from static data reliance to multidimensional dynamic integration; from expert-driven manual judgments to data-driven quantitative decisions; and from reactive responses to proactive early-warning systems^[8]. However, it is also crucial to consider the application logic and ethical boundaries of AI in this domain^[9].

As western China's financial hub, Sichuan Province has seen steady banking growth, with financial institutions holding over 12 trillion yuan in deposits and 10 trillion yuan in loans by end-2025. However, rapid expansion has exposed systemic compliance shortcomings. Recent high-profile cases—including a 4.8 million yuan fine against a joint-stock bank's Chengdu branch and a 7.28 million yuan penalty against a provincial-level city commercial bank—highlight urgent needs for risk prevention improvements. Against this backdrop, this study adopts a "diagnosis—analysis—design—recommendations" methodology to investigate how big data can enhance risk control in Sichuan's commercial banks, providing both theoretical insights and practical solutions.

2 Analysis of the Current Status and Problems in the Establishment of Credit Risk System of Sichuan Commercial Bank

2.1 Overview and Risk Characteristics of Sichuan Commercial Banks

By the end of 2025, Sichuan Province will host over 200 banking institutions. A provincial-level city commercial bank, launched in November 2020, has seen rapid growth with assets reaching 528.1 billion yuan by November 2025—a 400-billion-yuan increase with average annual growth exceeding 30%.

Sichuan's commercial banks exhibit three key risk characteristics: First, credit risks are distinctly regional, with traditional industries facing heightened exposure during capacity reduction^[10]. Second, small and medium-sized banks demonstrate weaker risk management capabilities, lagging in talent, technology, and data resources. Third, compliance

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management requires strengthening, as recent cases reveal frequent violations in anti-money laundering and account management.

2.2 Status of Credit Risk System Construction

Positive progress has been made. At the institutional level, banks are establishing comprehensive risk management frameworks compliant with regulatory requirements ^[11-12]. At the organizational level, most banks have independent risk management departments, with some implementing collaborative mechanisms between risk and client managers. In technological applications, some banks are exploring big data and AI, integrating external data sources and employing rule engines for automated approvals.

2.3 Main Existing Problems

Despite progress, multiple challenges remain:

First, the credit system is underdeveloped, lacking effective credit reporting and regulatory frameworks. Some banks operate with incomplete systems, limiting accurate customer creditworthiness assessment.

Second, information processing lags behind needs. Traditional models over-rely on static data with long update cycles, lacking integrated analysis of high-frequency dynamic data like transaction records and electricity consumption, resulting in delayed risk identification ^[13-14].

Third, credit business management mechanisms are inadequate, lacking essential early-warning and exit systems. Risk indicators remain incomplete, with insufficient technical support for assessment and decision-making.

Fourth, personnel competence is generally low, with insufficient big data proficiency. The absence of dedicated training departments and inadequate recognition of big data value hinder effective implementation.

Fifth, data silos are prominent with inefficient collaboration. Credit systems, AML systems, and core business operate in isolation, with fragmented data formats preventing unified visualization.

Sixth, systemic deviations in compliance management exist. In December 2025, a joint-stock commercial bank's Chengdu branch and four of its sub-branches were fined a total of 4.8 million yuan for imprudent practices across credit business, trade finance, bill business, and investment business—revealing systemic management flaws within the regional operations.

Seventh, frequent violations persist in anti-money laundering. In February 2026, a provincial-level city commercial bank received a 2.7457 million yuan fine for nine categories of violations spanning financial statistics, account management, fintech management, anti-counterfeit currency management, and anti-money laundering obligations—exposing gaps across entire operational chains.

2.4 Deep Analysis of the Causes of the Problem

From a technical perspective, digital transformation investments show structural disparities. Regional banks lag in technological adoption due to weak data infrastructure and talent shortage.

From a managerial perspective, the philosophy prioritizing scale over quality persists. While the aforementioned provincial-level city commercial bank's assets surpassed 500 billion yuan, its core Tier 1 capital adequacy ratio declined by 2.04 percentage points.

From a cultural perspective, compliance operations lack collective consciousness. Inadequate incentive mechanisms lead to low accountability and motivation. Recent penalty cases show that multiple departments have been found to have committed multiple violations, indicating that compliance awareness has not yet fully permeated from the document level into actual operation.

From an ecological perspective, data sharing mechanisms remain underdeveloped. Barriers between government, industry, and financial data hinder effective integration and analysis.

3 Analysis on the Path of Big Data Boosting the Construction of Risk Prevention and Control System of Sichuan Commercial Bank

3.1 Deeply Digging Data Value, Establishing Multi-dimensional Data Base

Data is the cornerstone of risk prevention. Traditional models rely on single-source financial information with delayed updates, making accurate risk assessment difficult. Big data technology can break down data barriers.

Commercial banks should systematically review five years of credit data, monitoring bad debt ratios and risk trends. Sichuan banks should develop regional credit data warehouses, analyzing default patterns across industries and

enterprise scales.

Integrating internal and external data is critical. Banks should establish frameworks incorporating structured data from core systems and external sources like tax records and judicial archives. Priority should be given to collaborating with provincial data centers and power utilities, incorporating high-frequency data like electricity consumption to address slow updates in traditional data. To forecast broader economic trends that impact credit risk, banks could leverage hybrid time-series models ^[15].

Achieving information symmetry through comprehensive credit assessments addresses lending information asymmetry. Establishing data governance mechanisms with unified standards ensures data integrity through secure storage and full lifecycle management.

3.2 Promoting Approval Automation and Building Intelligent Early Warning Models

Holding data is merely the first step; deriving actionable risk insights is the real challenge. Integrating AI technologies enables intelligent early-warning models spanning the entire credit lifecycle.

Automating approval processes boosts efficiency. Using machine learning algorithms, systems train predictive models for rapid risk detection, identifying fraud and evaluating creditworthiness ^[16]. For detecting sophisticated cross-border trade fraud or complex loan application fraud, models based on heterogeneous graph neural networks offer significant advantages. Continuous monitoring enables dynamic optimization, establishing self-iterative intelligent risk control ^[17].

Through classification and correlation analysis, banks develop multi-tiered evaluation systems detecting potential risks ^[18]. Monitoring macroeconomic trends enables prediction of systemic risk evolution. Advanced techniques like Multimodal Transformer Graph Neural Operator networks could be adapted from reservoir parameter prediction to model complex interactions within financial systems for more accurate risk forecasting ^[19].

Personal credit risk management exemplifies refined practices. Sichuan Commercial Bank could develop region-specific models incorporating local characteristics—production cycle models for agricultural operators and cash flow fluctuation models for small enterprises.

Natural language processing enables monitoring of news and social media, promptly identifying reputation risks for early-stage warning.

3.3 Integrate Big Data for End-to-End Management and Enable Tiered Response

Big data application runs through pre-loan, loan, and post-loan phases, forming a complete risk prevention closed loop.

In pre-loan phases, integrating internal and external data with behavioral analysis and blacklist screening preemptively identifies high-risk fraud clients. Analyzing multi-platform borrowing records detects organized fraud.

In loan disbursement, big data addresses risk pricing and credit limit management. Integrating comprehensive reports with external data enables differentiated pricing and precise credit allocation.

In post-loan phases, lenders continuously monitor risk behaviors through job changes, overdue loans, and court records to promptly identify potential risks ^[20]. The concept of digital supply chain integration and its impact on operational resilience can inform the development of resilient post-loan monitoring systems that adapt to a borrower's changing operational environment ^[21].

Sichuan commercial banks should establish risk signal classification mechanisms, categorizing signals by level to focus resources on highest-risk areas. Systems automatically identify warnings and push to managers, triggering standardized verification procedures.

3.4 Expanding Big Data Application Depth, Deepening System Integration and Process Embedding

The greatest value of intelligent risk management lies in deep integration with business processes. Through standardized interfaces, systems connect warning mechanisms with credit management and core operations, creating comprehensive defense networks. During approvals, personnel can directly view historical risk signals. For anti-money laundering, suspicious transaction detection models embedded in payment processes enable real-time interception.

3.5 Establish Big Data Standards and Norms to Consolidate Management Foundation

Big data application must be grounded in standardized frameworks. Data collection requires effective screening based on business needs and industry trends to ensure scientific validity. Standards must comply with regulations while accounting for individual bank characteristics.

Data security constitutes fundamental requirements. Banks must implement multi-layered measures: encryption,

access control, and backup recovery. Robust encryption safeguards sensitive information; strict access control ensures only authorized personnel access confidential data. Regular security audits promptly identify vulnerabilities, ensuring secure system operation.

4 Discussion

Big data is driving the development of risk prevention systems in commercial banks, presenting both technical and strategic challenges. To address issues faced by Sichuan's commercial banks, coordinated efforts across data governance, model innovation, organizational transformation, ecosystem collaboration, and regulatory guidance are essential.

Strengthening data governance is the top priority. Banks should establish comprehensive frameworks spanning the entire data lifecycle, integrating big data with credit reporting systems to enable systematic credit evaluation. They must accelerate data standardization, break down departmental silos, and expand external data access channels—promoting sharing of public data from tax, industry, social security, and power utilities. Establishing quality monitoring mechanisms ensures data authenticity, laying a solid foundation for intelligent risk control.

Simultaneously, banks must accelerate model innovation by increasing R&D investments to build comprehensive matrices covering the entire credit lifecycle. This includes refining early-warning mechanisms with indicators for debt repayment capacity and financial performance, developing scientific incentive systems, and implementing flexible credit exit strategies. Full lifecycle management of models—from development to continuous monitoring—ensures long-term effectiveness. Equally important is organizational cultural transformation: establishing talent development departments, implementing systematic training programs, and overhauling performance evaluation systems to elevate compliance metrics alongside scale indicators.

Furthermore, establishing an open collaborative ecosystem is critical. Regulatory authorities should lead the development of regional financial risk information sharing platforms, facilitating compliant sharing of negative information to reduce multi-lender risks. Joint modeling mechanisms can assist small and medium-sized banks in improving risk control effectiveness, particularly in the area of MSME financing ^[22]. Finally, refining regulatory guidance mechanisms is indispensable—enhancing both internal and external supervision frameworks while incorporating data governance capabilities into regulatory evaluation systems, allowing differentiated transformation paths that respect institutional differences and ensure tangible results.

5 Conclusion

This study systematically examines the application of big data technology in enhancing credit risk prevention and control systems for commercial banks in Sichuan Province. Through literature review and case analysis, it reveals that while progress has been made in risk control infrastructure, significant challenges persist—including incomplete credit systems, delayed information processing, prominent data silos, and insufficient staff competency. Notable cases such as a joint-stock bank's Chengdu branch receiving 4.8 million yuan in penalties for systemic violations and a provincial-level city commercial bank receiving its first penalty of 2026 with 2.7457 million yuan in fines highlight the urgent need for comprehensive risk management reform.

Big data technology offers transformative potential for addressing these challenges. By establishing multidimensional data foundations, automating approval processes with intelligent early warnings, implementing tiered response mechanisms across workflows, and enhancing system integration, commercial banks can drive a fundamental transition from "experience-driven" to "data intelligence-powered" risk management. This transformation enables more accurate risk identification, real-time dynamic monitoring, and proactive early warning capabilities that traditional models cannot achieve.

To realize this vision, coordinated efforts across five key areas are essential: strengthening data governance foundations, accelerating model innovation capabilities, upgrading staff competency through organizational cultural transformation, building collaborative ecosystems for information sharing, and reinforcing regulatory guidance with differentiated approaches. For Sichuan's commercial banks, embracing this intelligent transformation is not merely an option but an imperative—essential for safeguarding regional financial stability and supporting the healthy development of the real economy in an increasingly complex risk landscape.

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