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**Article**

# Digital transformation of Commercial Banks in Kyrgyzstan driven by artificial intelligence: Efficiency, Risk and Policy Response

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**Abstract:** This study delves into the application of artificial intelligence (AI) in the digital transformation of Kyrgyzstan's commercial banks, its impact on economic efficiency and risk exposure, and proposes policy responses. Using panel data from 2019 to 2023 and a TOE analysis framework, it reveals an inverted U-shaped relationship between AI investment and bank efficiency, higher initial cybersecurity risks that diminish with system maturity, and significant government policy support. The study suggests dynamic risk management and regional fintech collaboration to boost the digital financial ecosystem in Kyrgyzstan and Central Asia.

**Keywords:** commercial bank; digital transformation; artificial intelligence; risk management; policy recommendations

## 1. Introduction

The rapid development of global fintech has driven profound changes in the banking sector. For Central Asian economies like Kyrgyzstan, digital transformation involves not only technological upgrades but also strategic priorities to enhance financial inclusion and national competitiveness. Dr. Isanov (2024) notes that Kyrgyzstan's digital transformation should be tailored to local conditions, focusing on the adaptability of technology and risk management. However, existing literature tends to focus more on developed economies, with less research available for regions

like Kyrgyzstan. The NBKR's 2023 Financial Stability Report highlights that the rapid growth of fintech has raised the bar for regulatory and bank risk management. Therefore, this study aims to use empirical analysis to explore the mechanisms, economic impacts, and risk profiles of AI in the digital transformation of Kyrgyzstan's commercial banks, and to propose practical policy recommendations

## 2.Theoretical framework and research hypothesis

This study constructs a localization analysis model from three dimensions: technology, organization, and environment, to better adapt to the characteristics of Kyrgyzstan's banking sector. In terms of technology, the focus is on AI computing power investment and data governance capabilities. According to KITA (2024), local banks face a shortage of data analysis talent. Regarding organization, it examines the management's awareness and strategic commitment, as well as cross-departmental collaboration efficiency. In terms of environment, it analyzes the incentive effects of government policies and financial regulations, particularly considering the geographical constraints of Kyrgyzstan as an inland economy, such as reliance on mineral exports and weak digital infrastructure. ASLANOV (2024), the chairman of the Kyrgyz Bankers Association, emphasized that a stable regulatory environment is crucial for banks' digital investment.

### 2.2 Research Hypotheses

Based on theoretical analysis and practical observation, the following hypotheses are proposed:

**H1:** There is an inverted U-shaped relationship between AI capital investment and bank operating efficiency.

**H2:** The depth of digital transformation of banks and the exposure of network security risks show periodic characteristics.

**H3:** Government policy support is positively regulating the speed of digital transformation of banks.

## 3. Research design and data sources

### 3.1 Sample selection and data collection

The study selected data from 20 major commercial banks in Kyrgyzstan for the period 2019-2023. Data sources included annual reports of banks, industry surveys, NBKR statistics, and market analysis reports (such as “Central Asia Fintech Watch”, 2024). Policy variable data were obtained by reviewing government documents and industry reports.

### 3.2 Variable definition and model setting

The study constructed fixed effect model, panel Poisson regression model and DID model to test the nonlinear relationship between AI input and operation efficiency, the phased characteristics of digital transformation depth and risk exposure, and the promoting role of policy support respectively.

## 4. Empirical results and analysis

### 4.1 Nonlinear relationship between AI investment and operation efficiency

The fixed effects model indicates that the coefficient of the first term for AI investment is significantly positive, while the coefficient of the second term is significantly negative, confirming Hypothesis H1. This suggests that moderate AI investment can enhance bank operational efficiency, but excessive investment may lead to resource wastage. ALMAZBEKOV et al. (2023) also found that there is an optimal range for technology investment, and over-investment does not necessarily lead to increased efficiency.

**Table 1**

*Changes in DEA efficiency of Bakai Bank from 2019 to 2023*

| Year | DEA Efficiency Score |
|---|---|
| 2019 | 0.78 |
| 2020 | 0.80 |

| | |
|---|---|
| 2021 | 0.82 |
| 2022 | 0.85 |
| 2023 | 0.88 |
| Data Source: Bakai Bank Annual Report and Author's Calculation | |

## 4.2 Risk exposure characteristics of deep digital transformation

The panel Poisson regression analysis indicates that the depth of digital transformation is significantly positively correlated with the frequency of cyber attacks during the early stages of the transition. According to the KG-Secure report (2024), attempts to attack the financial sector have increased over the past two years. However, as system maturity improves, risks are trending downward. In its 'Fintech Risk Warning for the First Half of 2024,' NBKR noted that while open API interfaces facilitate collaboration, security measures must be strengthened concurrently.

**Figure 2**

*Comparison of network attack frequency among different banks*

| Bank Name | Annual Cyber-Attack Frequency | Risk Category |
|---|---|---|
| Bakai Bank | 13 | Medium |
| Optima Bank | 22 | High |
| KICB | 19 | Medium |
| Demir Bank | 26 | Critical |
| Bai Tushum Bank | 21 | High |

Data Source: KG-Secure Report & Industry Interviews (2024)

## 4.3 Driving effect of policy support

The DID model analysis shows that the digital transformation of policy pilot banks is 2.3 times faster than the control group. For every one-unit increase in policy support, the transformation speed increases by 0.32 standard deviations, supporting H3. OROZOVA (2024) noted that government incentive programs have significantly accelerated the launch of digital products and customer adoption rates among banks.

Specific policies include the 'Digital Kyrgyzstan 2019-2023' roadmap, which prioritizes the digitalization of commercial communications.

# 5. Case analysis: practical insight and potential problems

## 5.1 Bakai Bank's "AI + Localization" practice

Bakai Bank's "AI + localization" strategy has achieved a 12.8% increase in operational efficiency through intelligent customer service and federated learning models (Figure 1). The bank's practice shows that the combination of local market needs and technology applications is key to successful transformation.

## 5.2 Cognitive and capability traps in digital transformation

Case studies highlight the cognitive and capability challenges banks face during digital transformation. A bank, for instance, misjudged the default rate of small and medium-sized enterprises (SMEs) by 28% due to the introduction of a generic risk control model that was not suitable for the local market. SAMAKOV (2023) noted that generic models are challenging to adapt to local markets, particularly in the microcredit sector for SMEs. Furthermore, some banks' over-reliance on external cloud service providers has sparked data sovereignty disputes, underscoring the importance of data localization and autonomy.

# 6. Risk management optimization and policy implications

## 6.1 Build a dynamic risk management framework

For different risk types, the following strategies are recommended:

· Market risk: Build a dynamic stress test platform and apply Monte Carlo simulation technology.

· Credit risk: Develop a federal learning scorecard using differential privacy technology.

· Digital risk: Implement zero trust architecture and use multimodal biometric identification technology.

### 6.2 Strengthen regional coordination and improve the ecological environment of regulatory technology

Promote the interconnectivity of financial data infrastructure in Central Asia, develop cross-border financial services based on smart contracts, and establish national or regional AI financial ethics and governance committees. BEKBOEVA (2024) suggests that it is crucial to promptly establish an ethical framework and define legal responsibilities for AI in critical infrastructure. The 'Digital Middle Corridor' project, in which Kyrgyzstan is involved, uses UN data standards to facilitate cross-border trade and has completed a cross-border digital currency payment test with China (such as a 50 million Dima transaction), providing a successful model for regional collaboration.

## 7. Research conclusions and prospects

This study confirms that Kyrgyzstan's commercial banks face both opportunities and challenges in AI-driven digital transformation. Moderate investment in AI can enhance operational efficiency, but it is crucial to be vigilant about cybersecurity risks during the early stages of transformation (Figure 2). Government policy support plays a vital role in accelerating digital transformation. Future research could focus on different types of banking operations, delving into their unique characteristics of digital transformation. For Kyrgyzstan and other Central Asian countries, prioritizing the development of local talent pools and building resilient, autonomous digital financial infrastructure are essential to support inclusive and sustainable economic growth in the region.

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