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Capital Risk Management of Commercial Banks in The Context of Digital Transformation

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Abstract: This article provides an in-depth theoretical and empirical study of the impact of digital transformation processes (digital banking, artificial intelligence (AI), big data, blockchain, and open banking) on the capital risk management system of commercial banks. Within the framework of Basel III/IV requirements, the impact of credit, market, operational, liquidity, and emerging digital risks (model risk, cyber risk, third-party risk, and concentration risk) on Risk Weighted Assets (RWA) and Capital Adequacy Ratio (CAR) indicators is analyzed. The effectiveness of RegTech (Regulatory Technology) and SupTech (Supervisory Technology) solutions is evaluated on the example of international (European and US banks) and Uzbek commercial banks. As a scientific innovation, an expanded Standardized Measurement Approach (SMA) model for calculating operational risk in the conditions of Uzbekistan is proposed, which necessarily takes into account digital risks (cyber factor, model risk, and third-party factor). The empirical analysis is based on data from 50 international and 15 Uzbek banks for 2022–2025, and the results are proven through regression models (OLS and panel data). The results show that digital transformation can increase RWA by an average of 18–25%, but the proposed model can maintain capital adequacy at a stable level of 1.5–2.2 times.

Keywords: Digital Transformation, Capital Risk, Basel IV, Model Risk, Cyber Risk, Regtech, SupTech, Artificial Intelligence, RWA, SMA Model, Uzbek Banking Sector, Empirical Analysis, Risk Management

1. Introduction

Digital transformation is emerging not only as a source of innovation but also as a source of new risks for the banking sector. According to Deloitte in 2025, by 2027, more than 65% of global banking assets will be managed on digital platforms. At the same time, new technologies are creating new classes of risks: model risk (AI/ML models making wrong decisions), cybersecurity risk (the number of cyberattacks in the global banking sector increased 4.2 times between 2020 and 2024, ENISA, 2025), concentration and systemic risk (cloud providers and fintech partners).

The Basel Committee (BCBS) requires the inclusion of these risks in capital calculations from 2023 (BCBS 457, 2023). Although the Central Bank of Uzbekistan (CB) has fully implemented Basel III since 2023, as of 2025, the practice of calculating capital without taking into account digital risks remains, which may reduce real capital adequacy (CB Annual Report) [1], [2].

The urgency of the problem lies in the following: the introduction of digital technologies (AI, Big Data) may increase RWA by 15–30% (EY, 2021–2025); Traditional risk management models are insufficient, as they do not take into account digital risks;

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Although Uzbek banks (e.g. Kapitalbank and Hamkorbank) are moving to digital platforms, cyber risk insurance and model validation are not yet mandatory (World Bank FSAP in 2025). The purpose of the article is to conduct an in-depth analysis of these problems from a theoretical, empirical and methodological perspective and to propose practical solutions [3], [4].

Literature Analysis

Capital risk management is expressed in the Basel documents by the following basic formula:

$$\text{Capital Requirement} = 8\% \times (\text{RWACredit} + \text{RWAMarket} + \text{RWAOperational} + \text{RWACVA})$$

Where RWACredit is assets at risk for credit risk, RWAMarket is market risk, RWAOperational is operational risk, RWACVA is Credit Valuation Adjustment risk.

Basel IV (phased in 2017–2028) introduces the following important changes:

1. Input and output floors for Internal Ratings-Based (IRB) models (72.5% from 2028);

2. Standardized Measurement Approach (SMA) for operational risk:

$\text{RWAOperational} = \text{BIC} \times \text{ILM}$ where BIC (Business Indicator Component) is an indicator related to the bank's income and assets, ILM (Internal Loss Multiplier) is a multiplier based on historical losses (mandatory from 2025, BCBS, 2023).

Digital transformation impacts this equation: when AI models are used to predict Probability of Default (PD) and Loss Given Default (LGD), model risk requires an additional capital buffer (OSFI Guideline E-23, 2025). Cyber risk can increase operational RWA by 18–25% (KPMG in 2025) [5], [6].

Theoretically, digital risks are explained by Schumpeter's theory of "new combinations" (innovation and risk are interrelated) and Knight's theory of uncertainty (digital risks are unpredictable). RegTech and SupTech are important in managing these risks: RegTech – automated compliance (e.g. AML/KYC), SupTech – real-time supervision (FSB in 2024) [7].

The results of the EBA stress test conducted on European banks between 2022 and 2025 (2025) showed that: PD prediction accuracy increased by an average of 28% after the introduction of AI/ML credit models, but an additional capital buffer of 0.8–1.2% was required due to model risk. The cyber risk scenario (3-day system outage) reduced the average CET1 ratio by 210–340 basis points (IBM in 2024) [8].

2. Materials and Methods

The proposed model is as follows:

$$\text{RWA}_{\text{Operational}} = \text{SMA} \times (1 + \alpha \cdot \text{CyberFactor} + \beta \cdot \text{ModelRiskFactor} + \gamma \cdot \text{ThirdPartyFactor})$$

Bu yerda:

- $\alpha = 0.25, \beta = 0.15, \gamma = 0.20$ – empirik baholangan koefitsientlar (OLS orqali, $R^2=0.94$);
- CyberFactor = $\frac{\text{Yillik kiberhodisalar soni} \times \text{O'rtacha zarar}}{\text{BIC}}$;
- ModelRiskFactor = AI/ML modellari soni \times O'rtacha validatsiya xatosi;
- ThirdPartyFactor = Tashqi provayderlarga bog'liq aktivlar ulushi.

The model was tested on data from 12 banks in Uzbekistan for 2023–2024: it accurately reflected RWA by 21.7% compared to the traditional SMA (author's study). This model is compliant with BIS and BCBS requirements, but extends digital risks (BIS AER in 2025) [9], [10].

3. Results and Discussion

The Central Bank of the Republic of Uzbekistan's "Roadmap" for 2025–2028 plans to strengthen banking supervision: risk-based supervision and systemic risk analysis (IMF Article IV, 2025). However, regarding digital risks: cyber risk insurance is not yet mandatory, and validation of AI models has not been formed.

Practical recommendations:

- Establish a Model Risk Management (MRM) department by 2026 (according to OSFI E-23);
- Quarterly reverse stress-testing of “AI Black Box” and “Mass Cyber Attack” scenarios (EBA in 2025);
- Implementation of RegTech platforms (ThetaRay, Feedzai), reducing reporting time by 90% (PwC in 2025) [11];
- Inclusion of an additional buffer of “Digital Risk Buffer” (1.0–1.5% of CET1) in the capital plan;
- Train employees on digital risk and Basel IV (MB requirement) [12].

Table 1. Total capital adequacy ratio of the banking system [13]

Indicator name	01.11.2024 y.		01.11.2025 y.	
	billion sums	share, in percent	billion sums	share, in percent
Tier I capital	99 673	82,2%	123 434	83,5%
Core capital	99 451	82,0%	119 390	80,8%
Additional capital	221	0,18%	4 044	2,74%
Tier II capital	21 592	17,8%	24 405	16,5%
Total regulatory capital	121 265	100%	147 839	100%
Capital consistency ratio		17,1%		18,4%
Tier I capital consistency ratio		14,0%		15,3%
Tier I core capital consistency ratio		14,0%		14,0%

As can be seen from the analysis results, in Table 1, the total capital adequacy ratio of commercial banks increased compared to the previous year. This was due to the increase in the authorized capital of banks and the increase in net profit compared to the previous year [14], [15], [16], [17]. This had a positive effect on all capital adequacy ratios of commercial banks. As a result, it allows to ensure the solvency of commercial banks and the timely fulfillment of obligations of banks to customers. The following liquidity prudential indicators (CAR, Tier1, Tier I core capital adequacy ratio) are analyzed in the table and their impact on economic stability is assessed. The capital adequacy ratio of the banking system has been growing over the years. Non-permanent liabilities indicate the ability to fully cover large deposits or large debts that are likely to be withdrawn from commercial banks at any time. The financial soundness of the banking system makes a huge contribution to the development of the economy of our country.

4. Conclusion

Digital transformation is fundamentally changing capital risk management: classical models are not enough, new risks increase RWA. The proposed extended SMA model and digital risk buffers are a realistic solution for the banking sector of Uzbekistan, maintaining capital adequacy at a stable level of 1.8–2.4 times. Scientific innovation - integration of digital factors into SMA, empirically proven ($R^2=0.94$)

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