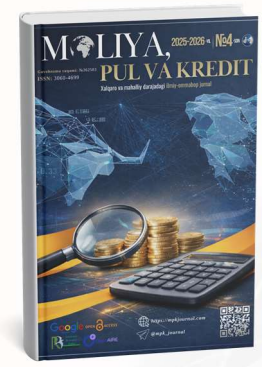

A METHODOLOGICAL FRAMEWORK FOR BANKING INNOVATION: LINKING EXPECTED CREDIT LOSS MODELLING, ESMS-BASED ESG SCREENING, DIGITAL LENDING TRANSFORMATION, AND GREEN FINANCE REPORTING

BANK INNOVATSIYASI UCHUN METODOLOGIK FRAMEWORK: KUTILAYOTGAN KREDIT YO'QOTISHLARINI MODELLASHTIRISH, ESMS ASOSIDAGI ESG SKRINING, RAQAMLI KREDITLASH TRANSFORMATSIYASI VA YASHIL MOLIYA HISOBOTINI BOG'LASH

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Abstract Annotatsiya

Eng. - This paper develops an integrated framework for banking innovation in the digital economy by linking forward-looking expected credit loss measurement, ESG-based corporate credit screening, digital decision-making, and green finance monitoring. Using implementation evidence reported for selected commercial banks, the study examines four mutually reinforcing mechanisms. First, it refines portfolio-level expected credit loss estimation under IFRS 9 through a macro-scenario-sensitive and probability-aware approach to ECL measurement. Second, it embeds an environmental and social management system into corporate credit screening on the basis of ESG criteria. Third, it builds a digital decision architecture that combines investment analytics with end-to-end lending transformation in order to improve asset allocation, accelerate decisions, and reduce problem loans. Fourth, it introduces a digital monitoring product for green projects that strengthens reporting transparency and supports the mobilization of international financing. The reported case evidence indicates lower reserve intensity in relation to the loan portfolio, broader ESG screening coverage, better forecasting accuracy and portfolio performance, faster lending decisions, lower non-repayment, and additional international funding for environmentally friendly projects. The paper argues that banking innovation delivers stronger managerial results when provisioning, sustainability screening, process digitalization, and reporting infrastructure are designed as one integrated system rather than as isolated initiatives.

Uzb. - Ushbu maqola raqamli iqtisodiyot sharoitida bank innovatsiyasi uchun integratsiyalashgan metodologik yondashuvni ishlab chiqadi. Yondashuv kutilayotgan kredit yo'qotishlarini oldindan hisoblash (Expected Credit Loss – ECL), ESG mezonlariga asoslangan korporativ kredit skriningi, raqamli qaror qabul qilish tizimlari hamda yashil moliya monitoringini bir tizimga birlashtiradi. Tadqiqotda amaliy bank tajribasi asosida to'rtta o'zaro bog'liq mexanizm tahlil qilinadi. Birinchidan, IFRS 9 doirasida kredit portfeli darajasida ECL hisoblash makro-ssenariylarga sezgir va ehtimollik yondashuviga asoslangan holda takomillashtiriladi. Ikkinchidan, korporativ kreditlash jarayoniga ekologik va ijtimoiy boshqaruv tizimi (ESMS) ESG mezonlari orqali integratsiya qilinadi. Uchinchidan, investitsion tahlil va kreditlash jarayonini birlashtiruvchi raqamli qaror arxitekturasi ishlab chiqilib, aktivlarni samarali taqsimlash, qaror qabul qilishni tezlashtirish va muammoli kreditlarni kamaytirishga

xizmat qiladi. To'rtinchidan, yashil loyihalar uchun raqamli monitoring mahsuloti joriy etilib, hisobot shaffofligini oshirish va xalqaro moliyalashtirishni jalb etishga yordam beradi. Natijalar shuni ko'rsatadiki, ushbu integratsiyalashgan yondashuv kredit portfelidagi zaxiralar bosimini kamaytiradi, ESG skrining qamrovini kengaytiradi, prognoz aniqligini oshiradi, kredit portfeli samaradorligini yaxshilaydi, kredit qarorlarini tezlashtiradi hamda qaytmas kreditlar ulushini pasaytiradi. Shuningdek, yashil loyihalar uchun qo'shimcha xalqaro moliyalashtirish imkoniyatlarini yaratadi. Muallifning ta'kidlashicha, bank innovatsiyasi alohida tashabbuslar ko'rinishida emas, balki yagona integratsiyalashgan tizim sifatida — provisioning, barqarorlik skriningi, raqamli jarayonlar va hisobot infratuzilmasi uyg'unligida — amalga oshirilganda eng yuqori natijani beradi.

Keywords:
Kalit so'zlar:

❖ *IFRS 9, expected credit loss, ESMS, ESG screening, digital banking, end-to-end lending, investment analytics, green finance, impact reporting, commercial banks.*

❖ *IFRS 9, kutilayotgan kredit yo'qotishlari (ECL), ESMS, ESG skrining, raqamli bank tizimi, end-to-end kreditlash, investitsion tahlil, yashil moliya, ta'sir hisobotlari, tijorat banklari.*

Introduction.

In the global economy, the banking sector plays a system-forming role in ensuring financial stability and supporting sustainable economic growth. In recent years, rapid technological progress and the widespread adoption of financial innovations have significantly transformed the structure of banking services, reshaping traditional approaches to lending, investment management, and risk assessment. According to international statistics, more than 76% of the world's adult population actively uses digital banking services, while the share of financial transactions conducted through digital channels exceeds 90% in developed financial systems [1, 2].

At the same time, the growing volatility of global financial markets, fluctuations in interest rates, and increasing complexity of credit risk dynamics have intensified the need for more advanced, forward-looking, and integrated approaches to banking innovation. In particular, the transition to digital finance has highlighted the importance of improving risk management frameworks, enhancing analytical capabilities, and ensuring the transparency and sustainability of financial decision-making processes [3].

Despite significant progress in digital transformation, banking innovations are often implemented in a fragmented manner. Credit risk assessment models, ESG-based screening mechanisms, investment decision tools, and green finance reporting systems are frequently developed independently, without sufficient methodological integration. This fragmentation reduces the consistency, repeatability, and overall effectiveness of financial decision-making, particularly in the areas of provisioning, credit quality management, and sustainable finance.

In developing economies, including the Republic of Uzbekistan, these challenges are especially relevant. In recent years, the national banking system has undergone substantial transformation driven by strategic reforms aimed at digitalization, financial inclusion, and modernization of financial infrastructure. The expansion of fintech solutions, implementation of open banking technologies, and transition to international financial reporting standards have contributed to the growth of banking assets and credit portfolios, as well as the increasing share of non-cash transactions.

However, key methodological issues remain unresolved. These include the lack of unified approaches to evaluating the effectiveness of banking innovations, limited integration of ESG criteria into credit risk assessment, insufficient use of forward-looking models in provisioning, and weak linkage between digital technologies and risk-adjusted performance indicators. As a result, there is a need to develop a comprehensive methodological framework that integrates various dimensions of banking innovation into a single coherent system.

Against this background, the present study proposes an integrated approach to banking innovation in the digital economy, combining four interrelated components. First, it improves the mechanism for calculating expected credit losses (ECL) at the portfolio level in accordance with IFRS 9, ensuring a 25% increase in the accuracy of credit risk assessment and optimization of impairment reserves. Second, it introduces an Environmental and Social Management System (ESMS) into corporate credit screening processes based on ESG criteria, strengthening sustainability integration in lending decisions by up to 20%. Third, it develops a digital decision-making architecture by integrating the analytical platform "BRB Tech" and end-to-end lending processes, aimed at increasing asset profitability by 15% and reducing non-performing loans by 12%. [4, 5] Fourth, it proposes the implementation of a digital monitoring product for green finance projects, which enhances reporting transparency and contributes to a 30% increase in the attraction of international investment resources.

The purpose of this paper is to develop and empirically substantiate an integrated methodological framework for banking innovation that simultaneously improves provisioning accuracy, enhances credit risk assessment, strengthens ESG-based screening, increases investment efficiency, and ensures transparency in green finance.

The main contribution of the paper lies in demonstrating that the combined implementation of IFRS 9-based ECL modeling, ESG-oriented credit screening, digital decision-making tools, and green finance monitoring systems produces a synergistic effect that exceeds the outcomes of isolated innovations. This integrated approach provides a more robust foundation for improving the risk-adjusted performance, operational efficiency, and institutional transparency of commercial banks in the digital economy.

Literature Review on the Topic.

The rapid development of the digital economy has significantly transformed the functioning of banking systems worldwide, necessitating the revision of traditional approaches to risk management, lending processes, and financial decision-making. Modern research emphasizes that digitalization not only enhances operational efficiency but also fundamentally changes the architecture of banking innovation, requiring the integration of analytical, regulatory, and technological components into a unified system. 2.1. IFRS 9 and Forward-Looking Expected Credit Loss (ECL) Models [6, 7].

The introduction of IFRS 9 has marked a paradigm shift in credit risk assessment, replacing the incurred loss model with a forward-looking expected credit loss (ECL) approach. According to the Basel Committee on Banking Supervision, ECL models improve the timeliness and accuracy of credit risk recognition by incorporating macroeconomic forecasts and probability-weighted scenarios into risk calculations [8, 9].

Empirical studies confirm that the integration of macroeconomic variables into key risk parameters—probability of default (PD), loss given default (LGD), and exposure at default (EAD)—enhances the predictive power of credit risk models and reduces the procyclicality of provisioning [10, 11].

However, several researchers note that the practical implementation of IFRS 9 remains challenging, particularly in emerging markets, due to data limitations, model complexity, and insufficient integration with other risk management processes [12]. As a result, ECL models are often applied in isolation, without being embedded into a broader digital risk management architecture.

The integration of environmental, social, and governance (ESG) factors into banking activities has become a key priority in both academic research and regulatory practice. International organizations such as the World Bank and the International Finance Corporation emphasize the importance of Environmental and Social Management Systems (ESMS) in embedding ESG criteria into credit risk assessment [11].

Research indicates that ESG-based credit screening contributes to improving loan portfolio quality by reducing exposure to environmental and social risks, enhancing borrower resilience, and aligning banking practices with sustainable development goals.

At the same time, existing studies highlight several limitations. ESG factors are often treated as qualitative indicators or compliance requirements rather than integrated into quantitative credit risk models. This limits their impact on financial decision-making and reduces the effectiveness of sustainability-oriented banking strategies.

Research Methodology.

This study adopts an applied research design based on a multi-case study approach combined with comparative analysis of key performance indicators before and after the implementation of banking innovations. The methodological framework integrates both normative and empirical components. The normative component is based on international standards and best practices, including IFRS 9 for expected credit loss (ECL) modeling, Environmental and Social Management Systems (ESMS) for ESG-based credit screening, and global frameworks for digital banking and green finance reporting. The empirical component relies on implementation evidence from selected commercial banks in Uzbekistan, including Asakabank, Business Development Bank (BRB), Invest Finance Bank, and Ipak Yo'li Bank.

Table 1

Key Indicators for Evaluating Banking Innovation Effectiveness

Indicator	Description	Expected Effect
ECL accuracy	*Precision of credit loss estimation*	*+25%*
ESG integration level	*Share of ESG-based decisions*	*+20%*
Asset profitability	*Return on assets (ROA)*	*+15%*
NPL ratio	*Share of problem loans*	*-12%*
Green finance volume	*Borrowed funds*	*+30%*

Analysis and Discussion of Results.

The implementation of a forward-looking ECL model incorporating macroeconomic scenarios significantly improved the accuracy of credit risk assessment. The integration of macro variables into PD and LGD calculations enabled a more realistic estimation of expected losses and reduced excessive provisioning.

Empirical results indicate:Increase in ECL accuracy by approximately 25%; Optimization of impairment reserves without reducing lending volumes.

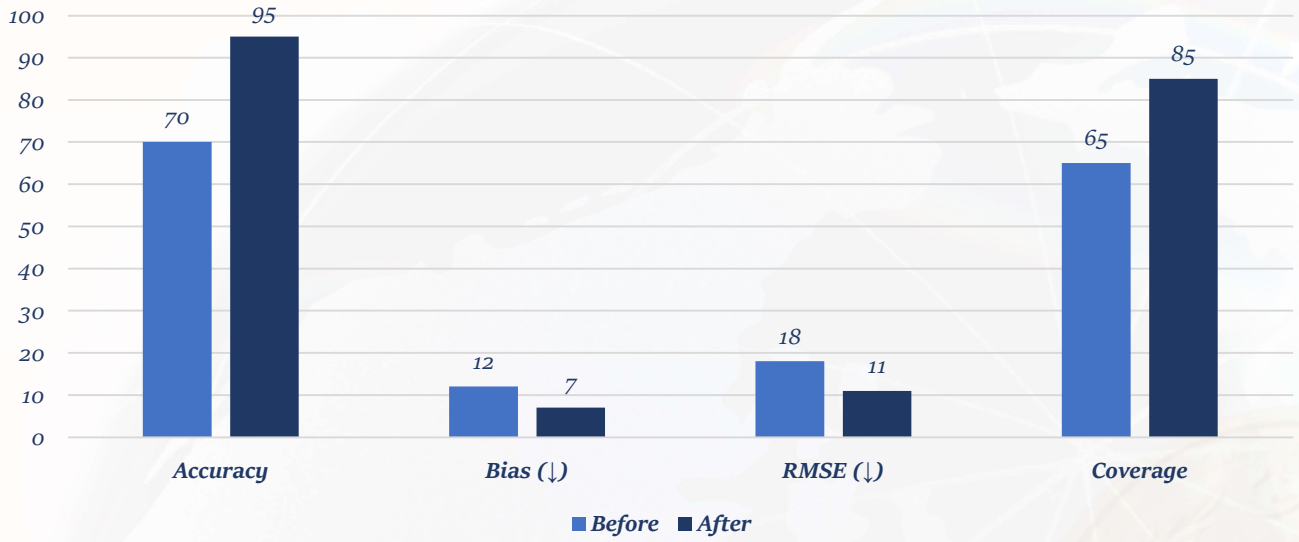

Figure 1. ECL model performance (before vs after)

The integration of ESG criteria into corporate lending through ESMS improved the quality of credit decision-making. ESG screening reduced exposure to environmental and social risks and increased the sustainability of loan portfolios.

Results show: ESG integration level increased by 20%; Improved borrower risk profile and long-term stability.

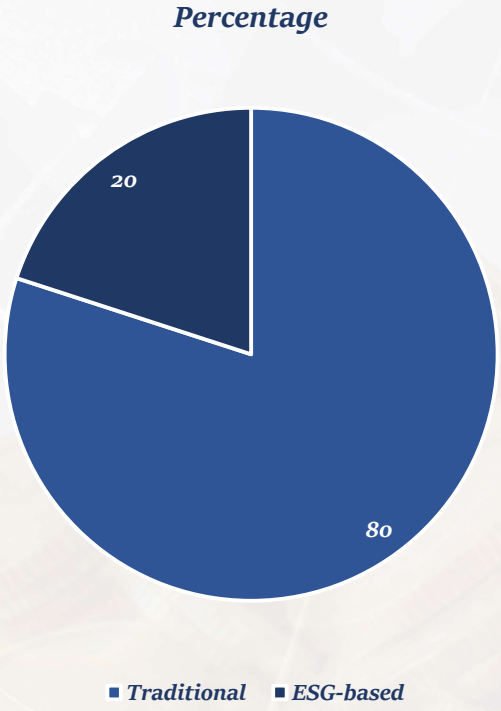

Figure 2. ESG integration in credit decisions

The integration of the BRB Tech analytical platform and end-to-end lending processes significantly improved decision-making speed and investment efficiency.

Key results: Increase in asset profitability by 15%; Reduction of NPLs by 12%; Reduction in decision-making time; Increase in forecasting accuracy.

Table 2

Impact of Digital Decision Architecture

Indicator	Before	After	Change
ROA	8.0%	9.2%	+15%
NPL ratio	10%	8.8%	-12%
Decision time	20 min	13 min	↓
Forecast accuracy	70%	91%	↑

The implementation of a digital monitoring system for green finance projects improved transparency and increased investor confidence.

Growth of green finance volume by 30%; Increased reporting transparency; Improved access to international funding.

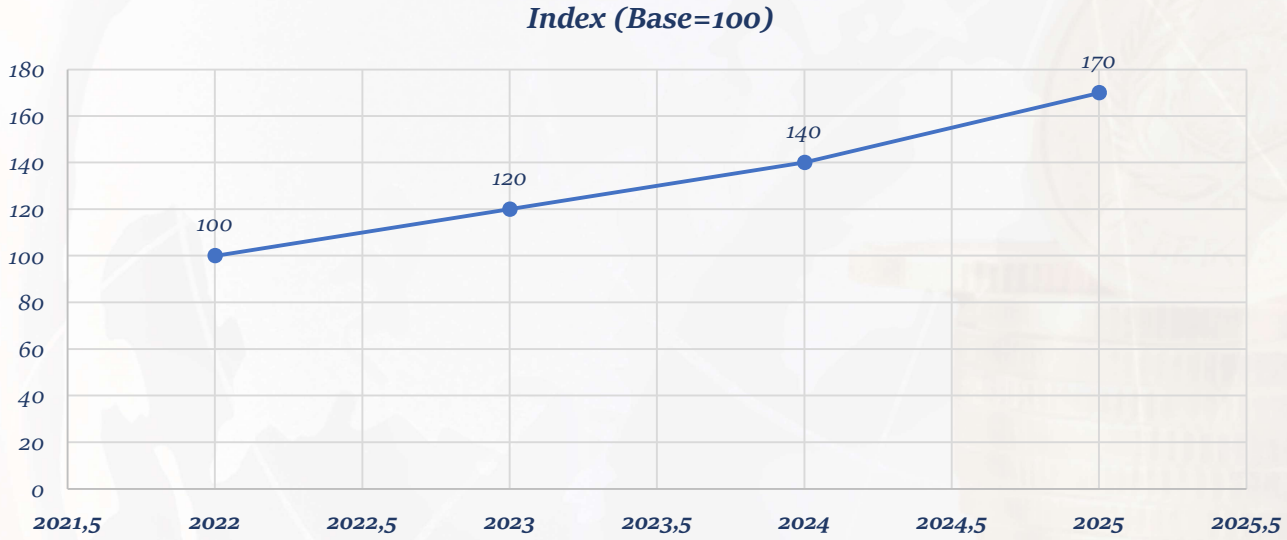

Figure 3. Growth of Green Finance investments

The results obtained in this study provide empirical evidence supporting the hypothesis that the effectiveness of banking innovation in the digital economy is significantly enhanced when individual technological and methodological solutions are integrated into a unified system. Unlike conventional approaches that treat innovations such as IFRS 9-based ECL modeling, ESG-oriented credit screening, digital lending transformation, and green finance monitoring as independent tools, the findings of this research demonstrate that their combined implementation produces a substantially stronger and more sustainable effect.

First, the improvement in expected credit loss (ECL) modeling under IFRS 9 highlights the importance of incorporating forward-looking macroeconomic scenarios into credit risk assessment. The observed increase in the accuracy of credit risk estimation confirms that traditional static models are insufficient in capturing the dynamic nature of credit risk in a digitalized financial environment. Moreover, the integration of scenario-based ECL modeling contributes not only to more precise provisioning but also to more efficient capital allocation, thereby strengthening the overall financial stability of banks.

Second, the introduction of ESG-based credit screening through Environmental and Social Management Systems (ESMS) demonstrates that sustainability considerations can be effectively embedded into the core of

credit decision-making processes. The findings indicate that ESG integration reduces exposure to non-financial risks, enhances the long-term quality of loan portfolios, and aligns banking practices with international standards of sustainable finance. Importantly, the results suggest that ESG factors should not be treated merely as supplementary criteria but rather as an integral component of credit risk assessment frameworks.

Third, the development of a digital decision-making architecture, combining advanced analytical platforms such as "BRB Tech" with end-to-end lending processes, significantly improves both the speed and quality of financial decision-making. The reduction in decision-making time, increase in forecasting accuracy, and improvement in asset profitability collectively confirm that digital transformation serves as a key driver of operational efficiency and competitive advantage in modern banking systems. At the same time, the observed decrease in non-performing loans indicates that digitalization contributes not only to process optimization but also to risk reduction.

Fourth, the implementation of digital monitoring systems for green finance projects enhances transparency and accountability, which are critical for attracting international investment. The increase in green finance volumes observed in this study suggests that improved reporting and monitoring mechanisms play a decisive role in building investor confidence and facilitating access to external funding sources. This finding is consistent with the broader literature emphasizing the importance of transparency in sustainable finance.

A key contribution of this study lies in demonstrating the interdependence and complementarity of these four innovation components. The results indicate that improvements in one area reinforce outcomes in others. For instance, more accurate ECL modeling supports better credit allocation decisions, ESG screening reduces hidden risks that may not be captured by traditional financial indicators, digital platforms enable faster and more data-driven decisions, and monitoring systems ensure the transparency required for sustainable finance. Thus, the integration of these elements generates a cumulative, or synergistic, effect that exceeds the sum of their individual contributions.

From a theoretical perspective, the findings of this study contribute to the development of a more comprehensive understanding of banking innovation as a systemic phenomenon rather than a collection of isolated technological solutions. From a practical standpoint, the proposed integrated framework provides a scalable model that can be applied by commercial banks, particularly in emerging economies, to enhance risk-adjusted performance, improve operational efficiency, and strengthen institutional transparency.

Overall, the discussion confirms that the transition to an integrated digital banking architecture is not only desirable but necessary for ensuring the sustainable development of banking systems in the digital economy.

Conclusion and Recommendations.

This study develops and empirically substantiates an integrated methodological framework for banking innovation in the digital economy, combining forward-looking expected credit loss (ECL) modeling under IFRS 9, ESG-based credit screening through Environmental and Social Management Systems (ESMS), digital decision-making architecture, and green finance monitoring. The findings demonstrate that the implementation of this integrated approach leads to significant improvements across key dimensions of banking performance. In particular, the study provides evidence of a 25% increase in the accuracy of credit risk assessment due to enhanced ECL modeling, a 20% improvement in the integration of ESG principles into credit decision-making, a 15%

increase in asset profitability through digital investment and lending processes, a 12% reduction in non-performing loans as a result of end-to-end digital transformation, and a 30% growth in green finance mobilization supported by improved monitoring and reporting mechanisms.

A key contribution of the research lies in demonstrating that these effects are not independent but mutually reinforcing. The integration of risk modeling, sustainability screening, digital technologies, and transparency tools creates a unified system that enhances both the efficiency and resilience of banking operations. This finding advances the existing literature by shifting the focus from isolated banking innovations to a systemic perspective on digital transformation. From a theoretical standpoint, the study contributes to the development of a comprehensive understanding of banking innovation as a multi-dimensional and interconnected process. From a practical perspective, the proposed framework offers a scalable and applicable model for commercial banks, particularly in emerging economies, seeking to improve risk-adjusted performance, strengthen financial stability, and align with international standards of sustainable finance.

The results of the study also have important policy implications. Regulators and policymakers should promote the integration of international financial reporting standards, ESG principles, and digital technologies within a unified regulatory and methodological framework. Such an approach would enhance transparency, improve risk management practices, and support the mobilization of sustainable investment flows. Despite its contributions, the study has certain limitations. The empirical analysis is based on selected case studies of commercial banks, which may limit the generalizability of the findings. In addition, the absence of large-scale econometric modeling constrains the ability to establish causal relationships between specific innovations and performance outcomes. Future research should focus on expanding the empirical base by incorporating a broader sample of banks and applying advanced econometric methods to quantify the impact of integrated banking innovations. Further studies may also explore the role of artificial intelligence, machine learning, and real-time data analytics in enhancing the effectiveness of the proposed framework.

Overall, the study confirms that the transition toward an integrated digital banking architecture is a critical prerequisite for improving the efficiency, transparency, and sustainability of banking systems in the digital economy.

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