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FINANCIAL SECURITY AND SUSTAINABLE DEVELOPMENT IN THE CONTEXT OF DIGITALISATION: THE ROLE OF ARTIFICIAL INTELLIGENCE AND EXTERNAL ECONOMIC TURBULENCE

Purpose. To identify the relationship between the digitalisation of the financial sector, the application of artificial intelligence (AI) technologies, the impact of external economic factors, and the level of financial security of Kazakhstan in the context of the 2022 institutional reforms.

Design/Methodology/Approach. A systemic-institutional approach is applied using comparative and statistical analysis methods. The empirical base includes data from the Agency for Regulation and Development of the Financial Market (ARDFM), the National Bank of Kazakhstan, the IMF, the Basel Committee, and second-tier bank reports for 2020–2024.

Findings. Digitalisation has a dual impact on financial security: it enhances operational efficiency but simultaneously increases cyber risks and operational threats. AI tools for credit scoring and AML compliance form a new risk management profile. The 2022 constitutional reforms strengthened the institutional environment and reduced investment risk, creating favourable conditions for fintech development.

Originality. For the first time in the Kazakhstani context, a comprehensive analysis of three interrelated factors – digitalisation, AI, and external economic turbulence – is conducted within the framework of the 2022 constitutional reforms as an institutional determinant of financial security.

Keywords: financial security, digitalisation, artificial intelligence, financial risks, Kazakhstan.

Introduction

In recent years, the digitalisation of the financial sector has ceased to be a supplementary factor and has become a key element in ensuring the financial security of states. For the Republic of Kazakhstan, operating under conditions of growing external economic uncertainty driven by geopolitical shifts, sanctions pressure on key partners, and the volatility of commodity markets, this issue is of particular relevance.

The constitutional reforms of 2022, aimed at strengthening the rule of law, transparency of public administration, and accountability of state institutions, created a new institutional foundation for the development of the country's financial system.

Kazakhstan's trajectory of digital financial transformation gained significant institutional momentum with the State Programme "Digital Kazakhstan" (2017–2022), which set ambitious targets for the development of e-government services, broadband connectivity, and digital financial inclusion. The

programme catalysed the rapid expansion of the country's fintech ecosystem: by 2024, the number of registered fintech companies had grown threefold compared to 2019, and mobile banking penetration reached over 80% of the adult population. The Astana International Financial Centre (AIFC), operating as a regulatory sandbox under English common law, emerged as a key incubator for innovative financial services, attracting more than 200 fintech companies from across the Eurasian region. This confluence of state-led digital initiatives, an evolving regulatory environment, and an intensifying international context makes Kazakhstan a particularly instructive case study for examining how digitalisation, artificial intelligence adoption, and institutional transformation jointly shape financial security outcomes.

The purpose of this study is to identify the relationship between the digitalisation of the financial sector, the application of AI technologies, the impact of external economic factors, and the level of financial security of Kazakhstan, taking into account constitutional and legal transformations. The research

objectives are: to analyse theoretical approaches to financial security; to assess the impact of digitalisation; to investigate the role of AI in risk management; to analyse external economic factors; and to determine the significance of institutional reforms. The remainder of the paper is structured as follows: Section 2 reviews the theoretical and empirical literature on financial security, digitalisation, and AI, and identifies the research gap addressed by this study; Section 3 sets out the research question, hypothesis, and methodological design; Section 4 presents and discusses the empirical results in relation to prior international scholarship; and Section 5 concludes with the study's contribution, practical implications, limitations, and directions for future research.

Literature review

Contemporary research interprets financial security not only as the stability of a system, but also as its capacity to adapt to digital and external economic challenges. Unlike traditional approaches, which primarily emphasised capital adequacy and static prudential ratios, the emphasis in recent scholarship shifts towards integrating technology, behavioural data, and regulatory mechanisms into a dynamic, adaptive conception of security.

Theoretical foundations of financial security are developed in the work of Mishkin (2019), who defines it as a state of the financial system in which threats to stability are identified and neutralised with minimal losses. Claessens and Kose (2018) emphasise the macroprudential dimension of security as a prerequisite for preventing systemic crises, arguing that the interconnectedness of financial institutions requires supervision at the level of the system as a whole rather than of individual entities alone. Taken together, these two contributions frame financial security as both a static condition (capital and liquidity buffers) and a dynamic process (early identification and neutralisation of emerging threats) – a duality that is directly relevant to the digital transformation examined in this study.

The digitalisation of the economy and the development of fintech contribute to the formation of the concept of digital financial sovereignty, which presupposes control over financial flows and data in the context of globalisation. Tapscott and Williams (2006) were among the first to explore the potential of mass digital collaboration in transforming financial ecosystems. More recent work by Philippon (2019) demonstrates that fintech reduces transaction costs and expands financial inclusion while simultaneously creating new regulatory challenges, a tension

that recurs throughout the empirical findings of the present study.

The application of AI in finance is examined in the work of Buckley et al. (2020), who established that algorithmic credit scoring systems provide a more accurate risk assessment than traditional models. Arner, Barberis, and Buckley (2016) systematised the evolution of regtech solutions and their role in maintaining regulatory compliance. Berg et al. (2020) demonstrated that users' digital footprints enable the construction of credit scoring models with predictive power exceeding traditional methods, a finding that is echoed in the Kazakhstani context by the credit-scoring practices of Halyk Bank and Kaspi.kz discussed in Section 4.

Cyber risks as a consequence of digitalisation are examined by Bouveret (2018) and Crisanto and Prenio (2020): the former assessed potential losses from cyberattacks on financial institutions, while the latter proposed a regulatory response framework combining supervisory technology with operational resilience standards. Related threats of operational risk in AI implementation are addressed in the Financial Stability Board reports of 2017 and 2022, which trace the evolution of regulatory thinking from an initial focus on efficiency gains toward a more risk-aware posture concerning model opacity and third-party concentration.

The International Monetary Fund (2023) points both to the potential of AI in improving risk management efficiency and to the emergence of new systemic threats associated with algorithmic decision-making, including herding behaviour among institutions that rely on similar models. The Basel Committee on Banking Supervision (2021) formulated principles of operational resilience applicable to digitalised financial systems, which subsequently informed national-level regulatory responses, including those adopted by Kazakhstan's regulator.

The regulatory dimension of digital financial systems is further explored in the context of central bank digital currencies (CBDCs). Auer, Cornelli, and Frost (2020) document the global proliferation of CBDC pilots and highlight associated monetary policy implications for emerging market economies. Carstens (2021) argues that central bank digital currencies can reinforce monetary sovereignty while simultaneously posing challenges for financial intermediation and capital flow stability. In the context of post-Soviet economies, Senchenko and Murzagaliyeva (2022) analyse macroprudential regulation under conditions of financial instability, identifying the absence of harmonised digital asset frameworks as a key systemic vulnerability. The role of regulatory

sandboxes in fostering fintech innovation while managing systemic risk has been examined by Zetzsche, Buckley, Arner, and Barberis (2019), who argue that proportionate regulation, adapted to local institutional capacity, is a prerequisite for sustainable digital financial development. Complementing this regulatory perspective, Ablenov (2021) examines financial control and audit as domestic institutional mechanisms, emphasising that robust internal audit and public financial oversight functions are a necessary – though frequently underestimated – complement to externally oriented prudential regulation in preventing the accumulation of systemic risk.

The external economic dimension of financial security is examined in the work of Obstfeld and Taylor (2017), who investigated the mechanisms by which global financial shocks are transmitted to small open economies through trade, capital-account, and confidence channels. For the post-Soviet space and Kazakhstan specifically, this topic has been developed by Nurlybaev and Akhmetova (2023), who explored issues of digital financial sovereignty and argued that data localisation and control over critical financial infrastructure are becoming as important to national security as traditional macroprudential indicators.

Several research gaps emerge from this review. First, while the international literature has separately examined digitalisation (Philippon, 2019), AI-driven risk management (Buckley et al., 2020; Berg et al., 2020), and external shock transmission (Obstfeld & Taylor, 2017), few studies integrate all three dimensions within a single institutional analysis. Second, the existing Kazakhstani literature (Nurlybaev & Akhmetova, 2023; Senchenko & Murzagalieva, 2022; Ablenov, 2021) tends to address digital sovereignty, macroprudential regulation, or financial control as separate strands rather than as interacting components of a single security architecture. Third, none of the reviewed studies explicitly incorporates the 2022 constitutional reforms as an institutional variable shaping financial security outcomes, despite the reforms' direct bearing on judicial independence, property rights, and regulatory consolidation. Thus, despite an extensive body of foreign literature on individual aspects of financial security, digitalisation, and AI, a comprehensive analysis of their interaction as applied to Kazakhstan – accounting for the institutional reforms of 2022 – remains insufficiently studied. This paper aims to fill that gap by jointly examining digitalisation, AI adoption, external turbulence, and constitutional-institutional change as interacting determinants of financial security within a single analytical framework.

Methodology

Research Question. In what way do digitalisation, AI technologies, and external economic factors jointly determine the level of financial security of Kazakhstan under the conditions of the 2022 institutional reforms?

Hypothesis. The digitalisation of the financial sector, when accompanied by adequate regulatory oversight, enhances financial security; however, without proper regulation, it generates additional systemic risks that are amplified by external economic turbulence.

Research Methods. The methodological foundation combines systemic and institutional approaches with elements of comparative and statistical analysis. The systemic approach treats financial security as an emergent property of the interaction between digital infrastructure, regulatory institutions, and the external economic environment, rather than as the outcome of any single factor in isolation. The institutional approach is applied to assess how the 2022 constitutional reforms altered the incentive structures and supervisory capacity of Kazakhstan's financial regulators. Comparative analysis is used to benchmark national regulatory practice against international standards, including the Basel III capital and liquidity framework and the Financial Action Task Force (FATF) recommendations on anti-money laundering and countering the financing of terrorism. Descriptive statistical analysis is applied to indicators of digitalisation (non-cash payment share, fintech company registrations, mobile banking penetration), cyber-risk incidence, and macroeconomic turbulence (exchange rate, inflation, trade reorientation) to establish empirical patterns that are then interpreted against the theoretical framework developed in Section 2.

Data Sources. The empirical base comprises data from the Agency for Regulation and Development of the Financial Market (ARDFM), the National Bank of Kazakhstan, the International Monetary Fund, the Basel Committee on Banking Supervision, the Astana International Financial Centre FinTech Hub, and publicly disclosed second-tier bank reports for the period 2020–2024. Where institutional or regulatory documents were the primary source (for example, ARDFM supervisory reports and National Bank statistical bulletins), findings were cross-checked against at least one independent source, such as IMF or Basel Committee publications, to reduce the risk of single-source bias.

Research Stages. The study proceeds through five stages: (1) systematisation of theoretical approaches to financial security, digitalisation, and AI-

driven risk management; (2) analysis of digitalisation and AI implementation indicators in the banking sector of Kazakhstan; (3) assessment of the impact of external economic factors in 2022–2024; (4) analysis of the 2022 constitutional reforms as an institutional factor shaping the regulatory environment; and (5) synthesis of results and formulation of policy recommendations.

Research Results. The results of applying this methodology are presented and discussed in Section 4, structured around four thematic blocks that correspond to the research stages above: digitalisation and financial security, AI in financial risk management, external economic turbulence, and the institutional effects of the 2022 constitutional reforms.

Results and discussion

Digitalisation and financial security. The digitalisation of Kazakhstan’s financial sector is accompanied by the active introduction of remote banking services, the development of national payment infrastructure, and the implementation of a pilot digital tenge project. The share of non-cash payments exceeded 78% by 2024, which attests to a high degree of integration of digital technologies into the financial system. At the same time, the expansion of the digital environment increases cyber risks and fraud threats, requiring the strengthening of cybersecurity systems.

According to ARDFM data, the number of registered cybersecurity incidents in Kazakhstan’s financial sector increased by 34% in 2023 compared to 2022, reflecting the expanding attack surface created by accelerating digitalisation. In response, the regulator introduced mandatory Digital Operational Resilience requirements for second-tier banks, aligning national standards with the principles articulated by the Basel Committee (2021). Major banks established dedicated Security Operations Centres (SOCs), while the national financial intelligence unit expanded its digital monitoring capabilities. The AIFC FinTech Hub registered over 50 new technology-driven financial service providers in 2023 alone, illustrating the pace of ecosystem development. However, persistent gaps in cybersecurity talent pipelines, incident reporting frameworks, and cross-border information sharing remain priority areas for the ARDFM’s supervisory agenda. These challenges indicate that the pace of digital adoption has outstripped the development of corresponding protective infrastructure, creating a structural vulnerability that requires systematic regulatory attention. This pattern closely mirrors the dual efficiency–risk trade-off described

by Bouveret (2018) for advanced financial systems, suggesting that the cyber-risk consequences of rapid digitalisation are not unique to emerging markets but are amplified in Kazakhstan by a comparatively narrow cybersecurity talent base.

Artificial intelligence in financial risk management. AI is actively employed by Kazakhstani banks. Halyk Bank and Kaspi.kz use machine learning for credit scoring, reducing decision-making time from several days to seconds. Freedom Bank Kazakhstan has integrated NLP algorithms into compliance systems for anti-money laundering (AML). However, the concentration of algorithmic solutions among a limited number of providers creates a systemic “single point of failure” risk, consistent with the IMF’s (2023) warning about herding effects among institutions relying on similar models. This indicates a transition of Kazakhstan’s banking sector from traditional risk assessment models to digital ecosystems in which big data processing plays a central role – a trajectory broadly consistent with the international evidence of Berg et al. (2020) on the predictive power of digital-footprint-based credit scoring, though Kazakhstan’s experience differs in the degree of vendor concentration, which is markedly higher than in the more fragmented fintech markets studied in Western Europe and North America.

Beyond credit scoring, AI applications in Kazakhstan’s financial sector extend to fraud detection, customer segmentation, and regulatory compliance automation. Bank CenterCredit has deployed anomaly detection algorithms capable of identifying suspicious transaction patterns in real time, reducing fraud losses by an estimated 22% in pilot programmes. The ARDFM’s 2023 supervisory report noted that at least 12 of the country’s 21 second-tier banks had integrated machine learning into their operational processes, though the depth of integration varies considerably across institutions. A significant challenge is the interpretability of algorithmic decisions: under Kazakhstan’s current consumer protection framework, borrowers retain the right to human review of automated credit decisions, creating compliance tensions with fully automated AI pipelines. Furthermore, the limited pool of domestic AI engineering talent and the dominance of foreign technology vendors expose the sector to third-party dependency risks. These developments underscore the need for a dedicated AI governance framework within the ARDFM’s supervisory architecture, drawing on international best practices from the Financial Stability Board (2017, 2022) and emerging global regulatory standards for artificial intelligence in finance, and echo Arner et al.’s (2016) earlier observation that regtech adoption

tends to outpace the supervisory capacity required to govern it.

External economic turbulence. After 2022, Kazakhstan faced external economic risks: exchange rate fluctuations, inflationary pressure, and the impact of sanctions on trade channels. The National Bank carried out foreign exchange interventions and raised the base rate to 16.75% to stabilise the economy. The diversification of trade partners and the reduction of dependence on the oil sector remain strategic priorities. These threats correspond to the theoretical analysis by Obstfeld and Taylor (2017) on the transmission of global shocks to small open economies via trade and capital-account channels.

The quantitative dimension of external economic pressure on Kazakhstan's financial system is substantial. The tenge depreciated by approximately 9.4% against the US dollar in 2022, exhibiting continued volatility through 2023 as commodity export revenues fluctuated with global energy prices. Inflation peaked at 21.3% in February 2023, eroding household purchasing power and increasing the credit risk profile of retail loan portfolios. The reorientation of trade flows following geopolitical shifts in 2022 led to a measurable increase in trade turnover with China (+18%), Türkiye (+27%), and Gulf Cooperation Council countries, partially offsetting reduced linkages with Western markets. For the banking sector, the primary transmission channels of external shocks operated through the exchange rate and import price inflation, which increased operating costs and affected the quality of foreign currency-denominated loan books. Compared with the transmission mechanisms documented by Obstfeld and Taylor (2017) for small open economies more broadly, Kazakhstan's experience displays a distinctive feature: the partial cushioning effect of rapid trade reorientation toward China, Türkiye, and Gulf Cooperation Council partners, which is not a prominent feature of the advanced-economy cases typically emphasised in that literature. These dynamics highlight the continued importance of robust macroprudential buffers, active foreign exchange reserve management, and accelerated progress on economic diversification as complementary pillars of financial security.

Constitutional reforms of 2022 and financial stability. The 2022 reforms strengthened the institutional resilience of the economy, creating a more transparent and predictable environment for the functioning of the financial sector. Strengthening judicial independence and enshrining property rights protection mechanisms create favourable conditions for attracting investment, reduce institutional risks, and

form the legal basis for fintech development and the regulation of digital assets.

From a regulatory infrastructure perspective, the post-reform period accelerated the formal consolidation of supervisory authority over banking, insurance, and securities markets within the ARDFM as a single dedicated body, improving coordination on systemic risk monitoring. This institutional streamlining facilitated the adoption of a unified Digital Financial Assets Law in 2023, which established a legal framework for the issuance and circulation of tokenised assets within the AIFC jurisdiction. The reforms also introduced enhanced transparency requirements for state-owned enterprise financing, reducing quasi-fiscal risks that had previously complicated assessments of consolidated public sector financial exposure. Taken together, these institutional developments represent a structural improvement in Kazakhstan's financial governance architecture, with tangible implications for the risk-adjusted cost of capital, investor confidence, and the long-term sustainability of the financial system in the face of ongoing digital and geopolitical transformation. This finding is consistent with Claessens and Kose's (2018) macroprudential emphasis on system-wide supervisory coordination, and extends it by showing that constitutional-level institutional change – rather than sectoral regulation alone – can be a meaningful driver of the supervisory consolidation that macroprudential theory prescribes (Table 1).

Table 1
Financial risks and risk management methods

Risk type	Characteristics	Management method
Credit risk	NPL growth, borrower defaults	AI-based scoring, provisioning
Market risk	Currency and interest rate volatility	Hedging, VaR
Operational risk	Cyberattacks, IT system failures	Digital SOC centres, audit
Regulatory risk	Non-compliance with ARDFM standards	RegTech solutions, compliance monitoring
Liquidity risk	Shortage of liquid assets	Stress testing, LCR monitoring
Country risk	Sanctions, external turbulence	Diversification, NBK currency interventions

Source: compiled by the authors based on ARDFM, National Bank of Kazakhstan, and Basel Committee data (2024).

Conclusion

Aim and methods. The aim of this study was to conduct a comprehensive analysis of the interaction between digitalisation, AI, and external economic turbulence as applied to Kazakhstan's financial security, taking into account the institutional effect of the 2022 constitutional reforms. This aim has been achieved through a systemic-institutional approach combining comparative analysis of national and international regulatory practice with descriptive statistical analysis of digitalisation, cyber-risk, and macroeconomic indicators for 2020–2024.

Main findings. The findings show: (1) the digitalisation of the financial sector exerts a dual influence – it increases operational efficiency while simultaneously heightening cyber risks and operational threats; (2) AI forms a new toolkit for managing credit, compliance, and fraud risks, but requires adequate regulation by the ARDFM, given the systemic concentration risk created by reliance on a small number of algorithmic solution providers; (3) the external economic turbulence of 2022–2024 exposed the vulnerabilities of the commodity-based model and accelerated the diversification of foreign trade links; (4) the constitutional reforms of 2022 created a favourable institutional environment for enhancing investor confidence, strengthening the regulatory architecture, and ensuring the sustainable development of the country's financial system.

Scientific contribution. The key conclusion is that the balance between technological development and effective state regulation constitutes the systemic determinant of financial security in the context of digital transformation. The study's principal scientific contribution is the integration of three previously separately studied dimensions – digitalisation, AI-driven risk management, and external economic turbulence – within a single institutional framework that explicitly accounts for the 2022 constitutional reforms, thereby addressing the research gap identified in Section 2.

Practical implications. From a policy perspective, the study's findings support a set of actionable recommendations. First, the ARDFM should develop a dedicated AI Governance Framework for systemically important financial institutions, incorporating requirements for model explainability, algorithmic audit trails, and fairness testing. Second, cybersecurity resilience standards should be harmonised with international benchmarks, with particular attention to third-party vendor risk and cloud service concentration. Third, the diversification of fintech funding

channels – including venture capital, AIFC-listed instruments, and development finance institution support – would reduce dependence on bank-intermediated credit for technology-driven financial services. Fourth, macroprudential policy frameworks should be calibrated to account for the amplification effects of algorithmic decision-making during periods of external economic stress. Coherent implementation of these measures would substantially enhance the adaptive capacity of Kazakhstan's financial system in the face of ongoing digital transformation and global economic uncertainty.

Limitations. This study is subject to several limitations. First, the empirical base relies primarily on publicly disclosed regulatory and bank-level data for 2020–2024, which limits the granularity of institution-level analysis and precludes formal econometric testing of causal relationships between digitalisation, AI adoption, and financial security outcomes. Second, the systemic-institutional and comparative approach adopted here is inherently more suited to identifying structural patterns than to isolating the marginal effect of any single factor, such as the 2022 constitutional reforms, net of concurrent macroeconomic shocks. Third, the analysis focuses on second-tier banks and does not extend in depth to non-bank financial institutions, insurance companies, or the securities market, whose digitalisation and AI adoption trajectories may differ. These limitations suggest caution in generalising the findings beyond the Kazakhstani banking sector without further empirical validation.

Future research. Prospects for further research include: evaluating the effectiveness of ARDFM regtech solutions in the context of AI scaling, ideally using institution-level panel data once such data become available; analysing the impact of the digital tenge on monetary policy transmission; and conducting a comparative study of crypto-asset and digital-financial-asset regulation models across the Eurasian Economic Union (EAEU) countries, which would help to establish whether the institutional patterns identified for Kazakhstan generalise to the wider regional context.

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Data Availability Statement

The data supporting the findings of this study are available from publicly accessible sources cited in the References. Additional information is available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization, B.M.A. and R.B.S.; Methodology, B.M.A. and B.B.E.; Formal analysis, B.M.A. and G.Zh.Zh.; Investigation, B.M.A. and R.B.S.; Resources, B.B.E.; Data curation, G.Zh.Zh.; Writing – original draft preparation, B.M.A.; Writing – review and editing, R.B.S., B.B.E. and G.Zh.Zh.; Visualization, G.Zh.Zh.; Supervision, B.B.E.; Project admin-

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Use of AI Tools

Generative AI tools were used in a strictly auxiliary capacity during the preparation of this manuscript, limited to language editing and bibliography formatting. All AI-assisted output was reviewed, verified, and edited by the authors, who take full responsibility for the scientific content, accuracy, and integrity of the manuscript.

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