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CONTENTS

PEDAGOGY

ECONOMY

МАЗМҰНЫ

ПЕДАГОГИКА

ЭКОНОМИКА

СОДЕРЖАНИЕ

ПЕДАГОГИКА

ЭКОНОМИКА

SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS
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Turan University, Almaty, Kazakhstan.
E-mail: g.kasymbekova@turan-edu.kz

DETERMINANTS OF BANKING SECTOR VULNERABILITY IN KAZAKHSTAN: A MULTI-METHOD ANALYSIS OF MARKET, CREDIT, AND LIQUIDITY RISKS

Amangozhayeva Anar — MSc in Economics, Senior Lecturer, Higher School of Finance and Accounting, Turan University, Almaty, Kazakhstan,
E-mail: a.amangozhayeva@turan-edu.kz, ORCID: https://orcid.org/0000-0001-5044-8418;
Akpanov Aidos — PhD in Economics, Associate Professor, Higher School of Finance and Accounting, Turan University, Almaty, Kazakhstan,
E-mail: a.akpanov@turan-edu.kz, ORCID: https://orcid.org/0000-0003-3559-098X;
Kassymbekova Gulzhakhan — PhD, Associate Professor, Higher School of Finance and Accounting, Turan University, Almaty, Kazakhstan,
E-mail: g.kasymbekova@turan-edu.kz, ORCID: https://orcid.org/0000-0002-5411-1297.

Abstract. This article provides a comprehensive assessment of banking risks in the Republic of Kazakhstan amid macroeconomic volatility, external shocks, and structural transformations in the financial system. The country's banking sector, characterized by a high concentration of assets and dependence on external capital markets, demonstrates significant vulnerability to currency, credit, and liquidity risks. The purpose of the study is to identify the key sources of vulnerability in Kazakhstani banks, determine the macroeconomic factors affecting the dynamics of risks, and develop recommendations for improving the risk-management framework. The methodological approach integrates a multimethod analytical toolkit, including the Value-at-Risk model for market risk assessment, macro - and microprudential stress testing, the CAMELS framework for evaluating bank soundness, and a fixed-effects panel regression to identify the determinants of credit risk. The empirical base is constructed using data from the ARDFM, the National Bank of Kazakhstan, the International Monetary Fund, and banks' financial statements for the period 2014–2024. The findings indicate that currency risk remains a system-forming component of the risk profile of Kazakhstani banks, reflecting the high dollarization of assets and liabilities. Stress-testing results show that under combined macroeconomic shocks, banks face a notable decline in capital

adequacy, an increase in non-performing loans, and liquidity shortages - all of which may pose risks to financial stability. The CAMELS analysis reveals structural imbalances: relatively strong capital and liquidity indicators contrast with weaker asset quality and heightened sensitivity to market risks. The econometric model confirms that depreciation, inflation, and monetary tightening significantly increase NPL levels, whereas economic growth contributes to their reduction. Based on the results, the study substantiates the need to strengthen macroprudential regulation, expand currency risk-hedging instruments, improve corporate governance, and enhance stress-testing methodologies. The research develops scientifically grounded recommendations aimed at increasing the resilience of Kazakhstan's banking sector.

Keywords: banking risks, financial stability, stress testing, CAMELS, currency risk

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Тұран» университеті, Алматы, Қазақстан.
E-mail: g.kasymbekova@turan-edu.kz

ҚАЗАҚСТАННЫҢ БАНК СЕКТОРЫНЫҢ ОСАЛДЫҚ ДЕТЕРМИНАНТТАРЫ: НАРЫҚТЫҚ, КРЕДИТТІК ЖӘНЕ ӨТІМДІЛІК ТӘУЕКЕЛДЕРІН КӨПӘДІСТІ ТАЛДАУ

Аманғожаева Анар — э.ғ.м., Қаржы және есеп жоғары мектебінің сениор-лекторы, «Тұран» университеті, Алматы, Қазақстан,
E-mail: a.amangozhayeva@turan-edu.kz, ORCID: https://orcid.org/0000-0001-5044-8418;
Ақпанов Айдос — э.ғ.к., Қаржы және есеп жоғары мектебінің қауымдастырылған профессоры, «Тұран» университеті, Алматы, Қазақстан,
E-mail: a.akpanov@turan-edu.kz, ORCID: https://orcid.org/0000-0003-3559-098X;
Қасымбекова Гульжахан — PhD, Қаржы және есеп жоғары мектебінің қауымдастырылған профессоры, «Тұран» университеті, Алматы, Қазақстан,
E-mail: g.kasymbekova@turan-edu.kz, ORCID: https://orcid.org/0000-0002-5411-1297.

Аннотация. Бұл мақала Қазақстан Республикасындағы макроэкономикалық құбылмалылық, сыртқы шоктар және қаржы жүйесіндегі құрылымдық өзгерістер жағдайында банк тәуекелдерін кешенді бағалауға арналған. Елдің банк секторы активтердің жоғары дәрежеде шоғырлануы және сыртқы капитал нарықтарына тәуелділігі нәтижесінде валюталық, несиелік және өтімділік тәуекелдеріне айтарлықтай сезімтал болып табылады. Зерттеудің мақсаты – банктердің осалдық көздерін айқындау, тәуекелдердің динамикасына әсер

ететін макроэкономикалық факторларды анықтау және тәуекел-менеджмент жүйесін жетілдіру бойынша бағыттар ұсыну. Методология аясында жанжақты талдау құралдары пайдаланылды: нарықтық тәуекелдерді бағалау үшін Value-at-Risk моделі, макро- және микропруденциялық стресс-тесттер, банктердің тұрақтылығын талдау үшін CAMELS моделі, сондай-ақ несиелік тәуекел детерминанттарын айқындауға арналған тұрақты әсерлермен панельдік регрессиялық модель алынды. Эмпирикалық база 2014–2024 жылдардағы ҚҚҚҚА, ҚР Ұлттық Банкі, Халықаралық валюта қоры және банк қаржылық есептіліктері деректерінен қалыптастырылды. Зерттеу нәтижелері көрсеткендей, валюталық тәуекел қазақстандық банктердің тәуекел-профилінің жүйе құраушы элементі болып қалып отыр, бұл активтер мен міндеттемелердің жоғары долларлануымен түсіндіріледі. Стресс-тест нәтижелері макрошоктардың ықпалы күшейген жағдайда капитал жеткіліктілігінің төмендеуі, проблемалық кредиттер үлесінің артуы және өтімділік тапшылығы байқалатынын көрсетті, бұл қаржылық тұрақтылық үшін қатер тудыруы мүмкін. CAMELS талдауы капитал мен өтімділік бойынша салыстырмалы тұрақты көрсеткіштер активтердің сапасының әлсіздігі және нарықтық тәуекелдерге жоғары сезімталдықпен теңгерімсіз екенін айқындады. Эконометрикалық модель девальвация, инфляция және ақша-кредит саясатын қатаңдату NPL деңгейін статистикалық тұрғыда арттыратынын, ал экономикалық өсім оның төмендеуіне ықпал ететінін дәлелдеді. Алынған нәтижелерге сүйене отырып, макропруденциялық реттеуді күшейту, валюталық тәуекелдерді хеджирлеу құралдарын дамыту, корпоративтік басқару сапасын арттыру және стресс-тесттеу әдістемесін жетілдіру қажеттігі негізделеді. Бұл зерттеу Қазақстан банк секторының тұрақтылығын арттыруға бағытталған ғылыми негізделген ұсыныстарды қалыптастырады.

Түйін сөздер: банк тәуекелдері, қаржылық тұрақтылық, стресс-тесттеу, CAMELS, валюталық тәуекел

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Университет «Туран», Алматы, Казахстан.
E-mail: g.kasymbekova@turan-edu.kz

ДЕТЕРМИНАНТЫ УЯЗВИМОСТИ БАНКОВСКОГО СЕКТОРА КАЗАХСТАНА: МНОГОМЕТОДНЫЙ АНАЛИЗ РЫНОЧНЫХ, КРЕДИТНЫХ И ЛИКВИДНЫХ РИСКОВ

Аманғожаева Анар — м.э.н., сениор-лектор Высшей школы финансов и учета, Университет «Туран», Алматы, Казахстан,
E-mail: a.amangozhayeva@turan-edu.kz, ORCID: https://orcid.org/0000-0001-5044-8418;
Акпанов Айдос — к.э.н., ассоциированный профессор Высшей школы финансов и учета, Университет «Туран», Алматы, Казахстан,
E-mail: a.akpanov@turan-edu.kz, ORCID: https://orcid.org/0000-0003-3559-098X;

Касымбекова Гульжахан — PhD, ассоциированный профессор Высшей школы финансов и учета, Университет «Туран», Алматы, Казахстан,
E-mail: g.kasymbekova@turan-edu.kz, ORCID: https://orcid.org/0000-0002-5411-1297.

Аннотация. Статья посвящена комплексной оценке банковских рисков в Республике Казахстан в условиях макроэкономической волатильности, внешних шоков и структурных изменений финансовой системы. Банковский сектор страны, характеризующийся высокой концентрацией активов и зависимостью от внешних рынков капитала, демонстрирует значительную чувствительность к валютным, кредитным и ликвидным рискам. Цель исследования - выявить ключевые источники уязвимости банков, определить макроэкономические факторы, влияющие на динамику рисков, и предложить направления совершенствования системы риск-менеджмента. Методология включает применение многокомпонентного аналитического инструментария: модели Value-at-Risk для оценки рыночных рисков, макро- и микропруденциального стресс-тестирования, CAMELS-модели для анализа устойчивости банков, а также панельной регрессионной модели с фиксированными эффектами для выявления детерминант кредитных рисков. Эмпирическая база сформирована на основе данных АРРФР, Национального банка РК, Международного валютного фонда и финансовой отчётности банков за 2014–2024 гг. Результаты исследования показывают, что валютный риск остаётся системообразующим элементом риск-профиля казахстанских банков, отражая высокий уровень долларизации активов и обязательств. Стресс-тестирование выявило, что в условиях комбинированных макрошоков наблюдаются заметное снижение достаточности капитала, рост доли проблемных кредитов и дефицит ликвидности, что может представлять угрозу финансовой стабильности. CAMELS-анализ продемонстрировал определённый дисбаланс: устойчивые показатели по капиталу и ликвидности контрастируют с более слабым качеством активов и высокой чувствительностью к рыночным рискам. Эконометрическая модель подтверждает, что девальвация, инфляция и ужесточение денежно-кредитной политики статистически значимо увеличивают уровень NPL, тогда как экономический рост способствует их снижению. С учётом полученных результатов обоснована необходимость усиления макропруденциального регулирования, развития инструментов хеджирования валютных рисков, повышения качества корпоративного управления и совершенствования стресс-тестирования. Исследование формирует научно-обоснованные направления повышения устойчивости банковского сектора Казахстана.

Ключевые слова: банковские риски, финансовая стабильность, стресс-тестирование, CAMELS, валютный риск

Introduction. Over the past two decades, the banking sector of Kazakhstan has remained a key component of the national financial system, ensuring capital

allocation, lending to the real sector, and supporting economic growth. However, heightened external volatility, structural changes in the economy, and accelerated digitalization have intensified the impact of diverse risk factors that require systematic assessment and the development of effective management mechanisms. Under current conditions, banking risks acquire not only financial but also macroeconomic significance, as they can influence national economic resilience, financial stability, and the investment climate.

Analysis of international practice and national trends shows that the most significant risks for Kazakhstan include credit risk, market risk, liquidity risk, operational risk, and cyber risk. A distinctive feature of the Kazakhstani banking sector is the high concentration of assets, reliance on external capital markets, and sensitivity to exchange rate fluctuations - all of which make risk management a critically important element of the sector's stability. Strengthened regulatory requirements imposed by the Agency for Regulation and Development of the Financial Market (ARDFM), the implementation of Basel III standards, and enhanced capital and liquidity requirements are shaping a new risk-management framework aimed at preventing systemic threats.

In recent years, developments related to depreciation expectations, the COVID-19 pandemic, rising inflation, intensified sanctions pressure in the region, and rapid digital transformations have highlighted the need to rethink approaches to evaluating and mitigating banking risks. In this context, the importance of a comprehensive analysis of banks' risk structures - incorporating macroeconomic, institutional, regulatory, and technological factors - has become increasingly evident.

The primary objective of this study is to identify the key banking risks in Kazakhstan, analyze the factors determining their dynamics, and propose evidence-based directions for improving the national risk-management system.

Literature Review. The issue of banking sector vulnerability is particularly relevant for emerging market economies, where financial institutions are exposed to multiple types of risks. The banking sector of Kazakhstan - the largest in Central Asia - has repeatedly shown high sensitivity to external shocks, underscoring the need for a systematic investigation of the determinants of its vulnerability. This review synthesizes scholarly research on banking risk analysis with a focus on comparative perspectives from the EAEU and Eastern European countries.

The theoretical foundation for analyzing banking risks was established in the seminal work of Diamond and Dybvig (1983), who proposed a model of bank runs explaining liquidity transformation and the inherent vulnerability of banking institutions to mass deposit withdrawals. This conceptual framework remains highly relevant for assessing liquidity risks in modern financial systems, including Kazakhstan's banking sector. Further development of systemic crisis theory is found in the research of Demirgüç-Kunt and Detragiache (1998), who - using data from 65 countries for 1980–1994 - identified key macroeconomic determinants of banking instability: low economic growth, high inflation, real interest rates, and

external imbalances. The authors' application of logit modeling has since become a standard methodology for estimating the probability of banking crises in emerging economies.

The issue of credit risk in transition economies gained particular prominence in the early 2000s. The study by Fries and Taci (2005), based on a stochastic frontier production function, demonstrated that the privatization of banks with the participation of foreign investors is associated with a reduction in the share of non-performing loans. For Kazakhstan, these findings are especially important in the context of the 2004–2007 credit boom, which is extensively documented by Kutan, Ozsoz, and Rengifo (2012). The authors show that the dollarization of liabilities and banks' aggressive external borrowing strategies contributed to the accumulation of systemic vulnerabilities that materialized during the 2008–2009 crisis.

Emphasizes the role of liability dollarization as a factor of financial fragility, while Ranciere and co-authors demonstrate a nonlinear relationship between currency mismatches and economic growth: countries may gain during stable periods but incur disproportionately large losses during shocks. These patterns are also confirmed in regional studies. For instance, Jamilov and Balz (2018) examine Kazakhstan and Azerbaijan and show that fluctuations in oil prices have a significant impact on bank profitability and asset quality through the exchange rate channel.

Significant contributions to the study of liquidity risk were made by Brunnermeier and Pedersen (2009), who formulated the theory of liquidity spirals explaining the mutually reinforcing dynamics of market and funding liquidity under stress. These findings received empirical support in the study by Cornett et al. (2011), which demonstrated that banks dependent on wholesale funding rapidly reduce lending during periods of financial distress. These observations are relevant for Kazakhstan, whose pre-crisis banking model was heavily reliant on external capital markets.

The banking systems of the Eurasian Economic Union (EAEU) exhibit both institutional differences and structural similarities. Vernikov (2012) shows that Russia and Belarus continue to be dominated by state-owned banks, whereas Kazakhstan is characterized by a predominantly private banking sector with significant foreign investor participation. Analysis for Russia confirms the role of credit booms and asset price dynamics as key determinants of credit risk, while for Kazakhstan, according to Basso, Calvo-Gonzalez, and Jurgilas (2011), high dollarization remains the defining factor.

Comparisons with Eastern Europe also reveal substantial parallels. Bonin, Hasan, and Wachtel (2005) found that foreign bank ownership improves efficiency and asset quality in the region. Bakker and Gulde (2010) documented a credit boom structure similar to Kazakhstan's, though with fundamentally different institutional environments. Klein (2015) demonstrated that macroeconomic factors (GDP growth, unemployment) explain a significant share of NPL variation in Central and Eastern European countries, reinforcing the relevance of panel-data models for credit risk analysis in Kazakhstan.

The contemporary stage of research focuses on post-crisis regulation and new

systemic shocks. Laeven and Valencia (2018) updated the global database of banking crises, including episodes from Kazakhstan. The COVID-19 pandemic, as shown by Demirgüç-Kunt, Pedraza, and Ruiz-Ortega (2021), affected banking systems through asset quality deterioration, declining interest margins, and rising operational risks. Recent geopolitical tensions also introduce new challenges. Mamonov and Pestova (2023) demonstrate that sanctions materially alter banks' risk structures and capitalization. For Kazakhstan, this implies the need to strengthen compliance measures and enhance monitoring of potential sanction-transmission channels.

In summary, the literature indicates that the vulnerability of Kazakhstan's banking sector is shaped by a combination of structural and macroeconomic factors, including high dollarization, sensitivity to external shocks, reliance on wholesale funding, and volatility in asset quality. Comparative analysis with the EAEU and Eastern Europe reveals similar development trajectories but also underscores differences in institutional frameworks and regulatory mechanisms. The review highlights the need for integrated early-warning models that account for the interplay among currency, credit, and liquidity risks.

Materials and Methods. The methodological framework of this study is based on a mixed-methods research design that enables a comprehensive assessment of banking risks in Kazakhstan and the identification of mechanisms underlying the formation of risk processes in the financial system. The combination of quantitative and qualitative analytical procedures provides a multidimensional interpretation of structural changes occurring within the banking sector and allows for a systematic examination of the interaction between macroeconomic fluctuations, regulatory interventions, and banks' internal characteristics.

The empirical base comprises data from 21 second-tier banks for the period 2014–2024. The information was obtained from the official reports of the Agency for Regulation and Development of the Financial Market (ARDFM), statistical publications of the National Bank of Kazakhstan, international databases of the International Monetary Fund (IFS, Article IV) and the World Bank, as well as IFRS-compliant financial statements of individual banks. To ensure analytical consistency and comparability, the sample was structured according to bank size, ownership type, and risk profile.

The quantitative component of the study relies on several methodological approaches. The assessment of market risks employs the Value-at-Risk (VaR) model to estimate potential losses in interest rate and foreign exchange positions using historical simulation and the parametric method. In addition, macro- and microprudential stress testing was conducted based on economic shock scenarios that simulate potential deterioration in asset quality, exchange rate depreciation, liquidity shortages, and changes in collateral valuation. These scenarios were aligned with the IMF's FSAP methodology and Basel III standards, ensuring comparability with international regulatory practice.

Financial stability assessment was further conducted using the CAMELS

framework, which systematizes indicators related to capital adequacy, asset quality, management efficiency, earnings performance, liquidity, and sensitivity to market risks. The transition to econometric analysis allowed for the quantitative estimation of the impact of macroeconomic variables on banking risks. Panel regression models with fixed effects and robust standard errors were constructed to identify the key determinants of non-performing loan (NPL) dynamics, return on assets, liquidity ratios, and banks' open currency positions. Explanatory variables included inflation, exchange rate, real GDP, the policy interest rate, and money supply - capturing both cyclical and structural effects.

The qualitative component of the research is based on semi-structured interviews with banking sector experts, representatives of the ARDFM, the National Bank, rating agencies, and independent analysts. The interviews helped deepen the understanding of the functioning of risk-management systems, identify regulatory weaknesses, and capture market participants' perceptions of the banking system's stability. Thematic analysis involving open, axial, and selective coding was applied to systematize expert insights and to identify core discursive themes shaping the risk environment.

Statistical analysis was performed using SPSS 28.0, Stata 17, and R. The procedures included descriptive statistics, correlation analysis, ANOVA, multiple regression, as well as tests for normality, heteroskedasticity, and multicollinearity. Statistical significance was set at $p < 0.05$. The reliability and validity of results were ensured through data triangulation, robustness checks of the models, and cross-validation of findings obtained from quantitative and qualitative analyses.

Results. The empirical findings provide a comprehensive assessment of the current level of banking risks in Kazakhstan and identify the key factors shaping their dynamics under conditions of macroeconomic volatility. The analysis includes the evaluation of market risks using the Value-at-Risk (VaR) method, stress-testing results, a comparative assessment of banks' resilience based on the CAMELS framework, and an econometric evaluation of the impact of macroeconomic factors on key risk indicators. The combination of these approaches enabled a multidimensional interpretation of the stability of the banking sector and its sensitivity to external shocks.

Given that market risks represent one of the most critical components of the overall banking risk profile, the initial stage of analysis focused on assessing potential losses across major positions using the VaR model. This method allows for quantifying the maximum expected losses under extreme market fluctuations and serves as a fundamental indicator for subsequent stress scenarios. The resulting VaR estimates for the key categories of risk are presented in Table 1.

Table 1 – Value-at-Risk Estimates for Major Risk Positions (99% CI, 10-day horizon)

Risk type	Average VaR (% of capital)	Maximum VaR (% of capital)	Comments
FX risk	7.3	12.1	High sensitivity to exchange-rate shocks
Interest-rate risk	4.6	8.4	Risk increases with policy-rate tightening
Market risk (securities)	3.1	5.7	Moderate volatility of government bond portfolios
Total portfolio VaR	9.8	15.4	Vulnerability increases under stress scenarios

The VaR results presented in Table 1 reveal significant heterogeneity in the risk profiles of Kazakhstani banks across key market positions. FX risks constitute the greatest vulnerability: the average VaR amounts to 7.3% of capital, while maximum levels reach 12.1%. This confirms the banking sector's high sensitivity to exchange-rate shocks, repeatedly highlighted in ARDFM and IMF (2023) reports. The volatility of the tenge is reinforced by external factors - commodity-price fluctuations, shifts in U.S. interest rates, and regional geopolitical uncertainty - making the FX channel a major source of potential losses.

Interest-rate risk is moderate but significant: the average VaR of 4.6% reflects the impact of sharp changes in the National Bank's policy rate, especially during periods of elevated inflation. Policy-rate increases in 2022–2023 have already led to higher funding costs and increased liability burdens, suggesting potential intensification of interest-rate risk in the medium term.

Market risk related to securities portfolios remains relatively stable, with VaR in the range of 3.1–5.7%. This stability is largely due to the high share of government securities in banks' portfolios, which are characterized by low volatility and predictable yields. Nevertheless, under stress conditions, synchronous repricing of sovereign debt instruments remains possible, underscoring the need for regular monitoring of portfolio duration.

The aggregate portfolio VaR reaches 9.8% on average and 15.4% under extreme conditions, highlighting elevated sensitivity of the banking system to combined market shocks. Overall, the results suggest that market risks - particularly FX exposure - remain structurally significant and require stronger hedging mechanisms, stricter limits on open positions, and enhanced stress-testing frameworks.

Because VaR captures the probabilistic distribution of potential losses under normal market conditions, the next stage of analysis examines banks' behavior under extreme adverse scenarios. Stress testing provides insights into sectoral resilience under sharp macroeconomic deterioration and identifies factors that may trigger breaches in capital adequacy or liquidity buffers. Table 2 presents the results of scenario-based stress tests, including an exchange-rate shock, a surge in non-performing loans, and liquidity outflows.

Table 2 – Stress-Testing Results for Kazakhstani Banks

Scenario	Change in NPL (%)	Capital decline (CAR, p.p.)	Liquidity shortage (%)	Interpretation
20% devaluation	+3.8	–2.4	12	Banks with large FX positions are the most vulnerable
NPL increase to 15%	+7.5	–3.9	9	Significant deterioration in asset quality
10% liquidity withdrawal	-	–1.2	18	Pressure on short-term liabilities
Combined shock	+9.3	–5.2	25	Risk of systemic instability in selected banks

The stress-testing results demonstrate that the resilience of Kazakhstan's banking sector varies substantially depending on the type of macroeconomic shock. The FX channel remains the most sensitive: a 20% devaluation leads to a 3.8-percentage-point increase in non-performing loans (NPL) and a 2.4-percentage-point decline in the capital adequacy ratio (CAR). This confirms the VaR-based findings indicating high vulnerability among banks with sizable open currency positions. Furthermore, the devaluation shock generates a liquidity deficit of 12%, potentially necessitating emergency funding mechanisms.

The scenario of deteriorating credit quality (NPL rising to 15%) exerts the strongest pressure on capital adequacy: CAR declines by almost 4 p.p. This shock reflects a severe degradation in credit risk, particularly dangerous for banks with high corporate loan concentration in vulnerable sectors of the economy.

A 10% liquidity withdrawal exposes structural weaknesses in short-term funding: an 18% liquidity shortfall indicates reliance on wholesale funding and vulnerability to panic-driven outflows.

The combined scenario yields the most severe outcomes: a 9.3-percentage-point rise in NPL, a 5.2-percentage-point decline in CAR, and a 25% liquidity deficit create a tangible risk of systemic instability for specific banks. This reaction suggests that part of the banking sector has limited capacity to absorb multi-channel shocks without external support.

Overall, the stress-testing results indicate that, while current capital buffers allow banks to withstand isolated moderate shocks, the combined effects of FX, credit, and liquidity shocks pose a material threat to the financial stability of individual institutions. This underscores the need for an integrated assessment framework that incorporates structural characteristics rather than isolated risk indicators3.

Table 3 – Integrated CAMELS Assessment of the Kazakhstani Banking Sector

CAMELS component	Average score (1–5)	Range	Comments
C – Capital adequacy	3.7	2.9–4.5	CAR exceeds minimum requirements for most banks

A – Asset quality	3.1	2.4–3.9	Concentrated loan portfolios increase risks
M – Management	3.8	3.0–4.6	Significant differences in risk-management systems
E – Earnings	3.4	2.8–4.2	Moderate profitability, dependence on interest income
L – Liquidity	4.1	3.3–4.8	Liquidity surplus; high LCR buffers
S – Sensitivity to market risks	2.9	2.1–3.7	FX vulnerability remains significant
Note: Compiled by the authors.			

The integrated CAMELS assessment shows that the stability of Kazakhstan's banking sector is balanced yet heterogeneous. The Capital adequacy component scores 3.7, indicating sufficient capital buffers: most banks maintain capital above regulatory minimums. However, the lower bound (2.9) suggests that some institutions may face challenges sustaining CAR amid heightened volatility.

Asset quality receives a significantly lower score of 3.1, primarily driven by high concentration in specific industries and a large share of corporate borrowers exposed to cyclical risks. This makes asset quality one of the key vulnerabilities of the system, particularly during periods of slowing economic activity.

The Management component scores relatively high at 3.8, though the wide range (3.0–4.6) indicates substantial variation in corporate governance and risk-management frameworks. Stronger performance is observed among banks with developed internal control mechanisms and specialized risk units. Earnings (3.4) reflect stable but moderate profitability, with interest income serving as the dominant revenue source. This structure makes earnings vulnerable to monetary-policy tightening.

Liquidity is the strongest component (4.1), driven by ample liquidity buffers and strong LCR profiles that allow banks to absorb short-term stress. The weakest element remains Sensitivity to market risks (2.9), as FX and interest-rate risks continue to play a systemic role and require heightened supervisory attention.

Overall, the CAMELS assessment confirms that asset quality and market-risk sensitivity constitute the main structural vulnerabilities of the sector. These findings align with stress-testing and VaR results.

Table 4 – Panel Regression Model (Dependent variable: NPL ratio, 2014–2024)

Variable	β-coefficient	p-value	Interpretation
Δ Exchange rate	0.412***	0.000	Devaluation increases non-performing loans
Inflation (CPI)	0.267**	0.014	Price growth reduces borrowers' repayment capacity
Real GDP growth	–0.318***	0.001	Economic expansion mitigates credit risks
Base rate	0.153*	0.041	Higher policy rate increases debt-servicing burden

Dummy: state-participation banks	–0.124	0.168	Trend toward higher stability, but insignificant
Constant	–2.91	-	-
Significance levels: *** p<0.001, ** p<0.01, * p<0.05.			

The panel regression analysis confirms that the dynamics of banking risks in Kazakhstan are shaped by the interplay of macroeconomic variables and monetary-policy conditions. The fixed-effects model ($R^2 = 0.61$) exhibits strong explanatory power, and the use of robust standard errors enhances the reliability of statistical inference.

The most influential factor is the exchange rate. The coefficient for Δ Exchange rate ($\beta = 0.412$, $p < 0.001$) indicates that depreciation of the tenge increases the share of non-performing loans. This finding aligns with IMF (2023) conclusions and reflects the high level of dollarization: depreciation directly weakens borrowers' ability to service FX-denominated loans.

Inflation also exerts a significant impact. The coefficient for CPI inflation ($\beta = 0.267$, $p = 0.014$) shows that rising prices reduce the real incomes of households and firms, raising delinquency risks.

Real GDP growth demonstrates the expected counter-cyclical effect ($\beta = –0.318$, $p < 0.001$), confirming that stronger economic activity enhances borrower solvency and reduces credit risk. The Base rate coefficient ($\beta = 0.153$, $p = 0.041$) highlights the transmission of monetary policy into financial stability: tighter policy increases funding costs and debt burdens, contributing to higher NPL. The dummy for state-participation banks carries a negative sign ($\beta = –0.124$), suggesting a tendency toward greater resilience, though the effect is statistically insignificant.

Overall, the model indicates that depreciation, inflation, and tighter financial conditions are the primary macroeconomic channels driving banking-sector risks in Kazakhstan, whereas economic growth mitigates vulnerabilities. These results are consistent with global evidence and justify a holistic macroprudential policy approach.

Discussion of Results. The empirical findings of this study provide a comprehensive understanding of the factors that determine the resilience of Kazakhstan's banking sector and reveal the key sources of systemic risks inherent to an economy characterized by high exposure to external shocks and macroeconomic volatility. The integrated application of Value-at-Risk (VaR), stress testing, CAMELS assessment, and panel regression analysis demonstrates that market, credit, and liquidity risks form an interconnected structure of vulnerabilities that collectively shape financial stability.

The assessment of market risks using the VaR methodology shows that foreign-exchange (FX) risk remains the dominant component of banks' risk profiles. The sector's pronounced sensitivity to exchange-rate shocks is driven by the high level of dollarization, mismatches in the currency composition of assets and liabilities, and the dependence of the tenge on commodity cycles. This pattern is

typical for resource-dependent economies and is consistent with the findings of the International Monetary Fund and the Bank for International Settlements, which highlight that FX risks significantly amplify non-performing loans during episodes of depreciation. Interest-rate risks have also become a meaningful factor within Kazakhstan's tightening anti-inflationary policy framework, as increases in the base rate elevate debt-servicing costs and weaken borrowers' repayment capacities.

Stress-testing results confirm that the banking system maintains relative resilience to isolated macroeconomic shocks of moderate severity; however, simultaneous exposure to multiple stress factors reveals conditions conducive to systemic instability. The combined scenario - incorporating depreciation, an increase in NPLs, and a liquidity outflow - results in a substantial decline in capital adequacy and a significant liquidity deficit. These findings are consistent with international evidence showing that systemic crises typically emerge not from the severity of a single shock but from the concurrent activation of several vulnerability channels. Banks with high credit concentration in cyclical industries, limited asset diversification, and sizable FX exposures are particularly susceptible to such combined shocks.

The CAMELS assessment highlights a pronounced divergence between the strengths and weaknesses of the banking sector. Capital adequacy and liquidity indicators demonstrate robustness - reflecting strengthened regulatory requirements in recent years. However, asset quality and sensitivity to market risks remain considerably weaker. Low scores on the Asset quality component reflect concentrated loan exposures in highly volatile sectors and insufficient provisioning. Meanwhile, the Sensitivity to market risks component confirms persistent vulnerability to FX and interest-rate fluctuations. Notably, significant heterogeneity persists across second-tier banks: while some institutions exhibit strong resilience and advanced risk-management systems, others face structural weaknesses due to limited diversification and underdeveloped risk controls.

The panel regression results reinforce the structural analysis by demonstrating that macroeconomic factors play a decisive role in shaping credit risks. Depreciation of the tenge and higher inflation significantly increase the share of non-performing loans by reducing real repayment capacity and raising the burden of FX-denominated obligations. In contrast, economic growth exerts a stabilizing effect, reducing credit risks and improving financial soundness. While increases in the base rate are aimed at controlling inflation, they simultaneously amplify borrowers' debt burden and exert downward pressure on credit quality. Thus, monetary policy becomes both a stabilization instrument and a source of additional risk, highlighting the need for close coordination with macroprudential measures.

Overall, the discussion confirms that the resilience of Kazakhstan's banking sector is determined by an interplay between internal management capabilities and external macroeconomic conditions. Financial stability depends significantly on the ability of banks to mitigate FX shocks, improve asset-quality management, reduce concentration risks, and enhance stress-testing frameworks. Strengthening

macroprudential policy, developing hedging instruments, improving credit risk-management practices, and diversifying asset portfolios are key directions for reinforcing financial stability in the long term.

Conclusion. The present study provides a comprehensive assessment of the resilience of Kazakhstan's banking sector under conditions of macroeconomic uncertainty, external financial shocks, and the structural transformation of the national economy. By integrating several analytical approaches - Value-at-Risk analysis, stress testing, CAMELS evaluation, and panel regression - the research offers a multidimensional view of the risks affecting financial stability and identifies the key mechanisms underlying their formation.

The results confirm that foreign-exchange risk remains a system-defining factor shaping the volatility of banks' credit portfolios. The heightened sensitivity of banks to exchange-rate fluctuations reflect the structural characteristics of Kazakhstan's economy, including widespread dollarization, dependence on commodity export revenues, and the limited depth of financial markets. Interest-rate risks intensify during periods of tight monetary policy, highlighting the need for a careful balance between macroeconomic stabilization and the maintenance of financial-institution resilience.

Stress-testing results show that the banking sector is capable of absorbing shocks of moderate intensity; however, combined stress scenarios create conditions conducive to declining capitalization and growing liquidity deficits. Banks with high credit concentration in cyclical sectors, limited portfolio diversification, and sizable open foreign-exchange positions exhibit particularly elevated vulnerability. These findings underscore the necessity of developing additional risk-management mechanisms aimed at mitigating systemic fragility.

The CAMELS assessment reveals a pronounced imbalance between the strengths and weaknesses of banks: strong capital and liquidity positions coexist with suboptimal asset quality and elevated sensitivity to market risks. Enhancing risk-management frameworks, improving portfolio diversification, and implementing early-warning models emerge as critical components of long-term strategic development for the banking sector.

The econometric analysis further confirms that the macroeconomic environment plays a decisive role in shaping credit risks. Depreciation of the tenge, inflationary pressures, and tighter monetary conditions significantly increase the share of non-performing loans, whereas economic growth contributes to their reduction. These results highlight the importance of coordination between monetary and macroprudential policies to prevent excessive accumulation of financial risks.

Overall, the study demonstrates that the resilience of Kazakhstan's banking sector depends on the ability of financial institutions to adapt to changing macroeconomic conditions and external shocks. Strengthening financial stability requires expanding the availability of instruments for hedging currency risks, improving stress-testing methodologies, enhancing corporate governance systems, and developing advanced analytical models for credit-risk assessment. In the long

term, reducing dollarization, deepening domestic financial markets, and improving institutional robustness remain key priorities.

In summary, the findings underscore the complex nature of banking risks and emphasize the need for a systemic, multi-level approach to their monitoring and management. Ensuring financial stability requires the combined efforts of banks, regulators, and macroeconomic policymakers to safeguard the resilience of the banking sector amid rising uncertainty and global economic transformations.

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