

INNOVATION SCIENCE AND TECHNOLOGY

ISSUE 10, PART I / OCTOBER 2026

 **Acceptance of papers**



**Acceptance of
papers**

Published monthly



Topics

economics,
technology, social
sciences



EDITOR-IN-CHIEF:

Mirzaliyev Sanjar Makhamatjon ugli

DEPUTY EDITOR-IN-CHIEF:

Makhmudov Nosir Makhmudovich
DSc., Prof., Academician

DEPUTY EDITOR-IN-CHIEF:

Ochilov Bobur Bakhtiyor ugli – Senior
lecturer at TSUI

THE SCIENTIFIC-POPULAR ELECTRONIC
JOURNAL **"INNOVATION SCIENCE AND
TECHNOLOGY"** HAS BEEN REGISTERED
UNDER THE NUMBER **C-5669633** BY THE
AGENCY FOR INFORMATION AND MASS
COMMUNICATIONS (AOKA) OF THE
REPUBLIC OF UZBEKISTAN, EFFECTIVE
FROM OCTOBER 9, 2024.

CONTACTS

Phone: **+998 50 737 87 88**

Website: <https://ist-journal.uz>

Email: innovationist2025@gmail.com

The scientific electronic journal "Innovation Science and Technology" has been included in the list of scientific publications recommended for the publication of main scientific results of dissertations for the award of PhD and DSc degrees in economics and technical sciences, in accordance with the Resolution No. 370 of the Presidium of the Higher Attestation Commission of the Republic of Uzbekistan, dated May 8, 2025.

Editorial board:



Sharipov Kongiratbay Avezimbetovich,
Doctor of Technical Sciences (DSc), Professor



Abdurakhmanova Gulnora Kalandarovna, Doctor of
Economic Sciences (DSc), Professor



Cham Tat Huei,
Doctor of Philosophy (PhD), Professor (Malaysia)



Muhammad Imran Sadiq
Doctor of Philosophy in Economics (PhD), Professor,
Malaysia



Ahmed Aziz Ismail
Doctor of Technical Sciences (DSc),
Professor (Egypt)



Lee Chin
Doctor of Philosophy in Economics (PhD), (Malaysia)



Asongu Simplicie
Doctor of Philosophy in Economics (PhD), Cameroon



Rui Dang
Doctor of Chemistry (DSc), Professor, China



Zahoor Ahmed
Doctor of Philosophy in Economics (PhD), Turkey



Shujaat Abbas
Doctor of Philosophy in Economics (PhD), Russia



Tina A Coffelt
Doctor of Philosophy in Educational Sciences (PhD),
USA



Abdikarimova Dinara Rustamxanovna
Doctor of Economic Sciences (DSc), Professor

Kurbonbekova Mohichehra Turobjonovna
Doctor of Economic Sciences (DSc), Professor

Alimardonov Ilkhom Muzrabshokovich
Doctor of Economic Sciences (DSc), Professor



Razakova Barno Sayfiyevna
Doctor of Philosophy in Economics (PhD)



Khasanov Sarvar Ulugbek ugli
Doctor of Philosophy in Economics (PhD)



Kholikova Rukhsora Sanjarovna
Associate Professor (PhD)



Xoliyorova Shoxista Qahramon qizi
PhD in Economics, Assistant Lecturer at the Department TSUE

Nasiba G'anjon qizi Sattorova
PhD, Senior Lecturer at the Department of Banking

CONTENTS

IMPLEMENTATION OF THE IMPROVED METHODOLOGY IN PRACTICE AND ASSESSMENT OF ITS ECONOMIC EFFICIENCY	8
Eshniyazova Yulduz Yuldashbayevna	
EXPERIMENTAL OPTIMIZATION OF DESIGN AND ENERGY PARAMETERS OF A GARLAND-TURBINE MOBILE MICRO HYDROPOWER PLANT FOR FREE-FLOWING WATER	13
Sultonov Sanjarbe, Zokirov Islomjon, Nurillaev Ahadullo, Abdullaev Shavkat	
METHODOLOGY FOR INCREASING THE EFFICIENCY OF CREDIT OPERATIONS IN COMMERCIAL BANKS	19
Djumaniyazov Ikram Karimbaevich	
COMPARATIVE ANALYSIS OF A COMPACT RESIDUAL CONVOLUTIONAL MODEL AND LINEAR REGRESSION FOR IMAGE SUPER-RESOLUTION	27
Husan Arziqulov Normurod o'g'li	
COMPARATIVE EVALUATION OF MACHINE LEARNING ALGORITHMS AND CLASS IMBALANCE HANDLING STRATEGIES FOR CREDIT CARD FRAUD DETECTION	33
Mahmudova Dilnoza Avaz qizi	
DIGITAL TRANSFORMATION OF FINANCIAL RESOURCE MANAGEMENT IN PUBLIC SOCIAL SECTOR INSTITUTIONS	39
Khasanov Tulkin Axmatovich	
WAYS TO ENSURE THE STABILITY OF THE CAPITAL BASE OF COMMERCIAL BANKS	45
Isakov Isobek Janabay's son	
CROSS-DAY EXPERIMENTAL EVIDENCE OF THERMAL-LOAD SHIFTING IN A SOLAR-DRIVEN HYDRONIC RADIANT FLOOR WITH MACROENCAPSULATED RT52 PHASE CHANGE MATERIAL	50
Jurabek Kamolov, Sokhib Temirov, Marjona Makhmudova	
STUDY OF THE TRACTION DYNAMICS OF AN AGGREGATE CONSISTING OF A FRUIT-HARVESTING MACHINE AND ITS TWO-AXLE CONTAINER-CARRYING TRAILER PLATFORM	59
Norchayev Davron, Sardor Nigmatjonov, Norchayev Jaloliddin, Norchayev Rustam	
PRIORITY DIRECTIONS FOR STRENGTHENING THE FINANCIAL STABILITY OF AGRICULTURAL ENTERPRISES	67
Kulmatov Zafar Jumanazarovich	
METHODOLOGICAL APPROACHES TO DEVELOPING UNIVERSITY STUDENTS' DIGITAL COMMUNICATIVE COMPETENCE BASED ON EMOTIONAL INTELLIGENCE	73
Malikakhon Kamiljanova	
SIMULTANEOUS REMOVAL CHARACTERISTICS OF OIL AND HEAVY METAL IONS BY BIOFLOCCULANTS BASED ON THE CELLULOSE-DMAEMA/PEPA COMPOSITE	80
Xayitboeva Dilshoda, Ibragimov Nasrilla, Jumaev Anvarbek	
ECONOMIC ANALYSIS AND DEVELOPMENT STRATEGY OF THE WOOD-POLYMER COMPOSITES MARKET	84
Abdumalikova Zarnigor, Ayubova Indira, Jumaev Anvarbek	
ENERGY UTILIZATION ANALYSIS OF AGRICULTURAL DRYING BASED ON INTEGRATED SOLAR THERMAL AND PHOTOVOLTAIC ENERGY SUPPLY	89
Ibragimov Umidjon, Mirzayarova Sevara, Khujayorova Aziza	
RECENT ADVANCES IN THE SYNTHESIS OF NANOSTRUCTURED MATERIALS FOR ZINC-ION BATTERIES	96
Diyorbek Absattorov, Dilnoza Erimbatova, Murodjon Samadiy	
ENTHALPY-MODEL SELECTION AND PRACTICAL IDENTIFIABILITY OF A MACROENCAPSULATED RT52 RADIANT FLOOR UNDER UNCERTAIN BRANCH FLOW	101
Jurabek Kamolov, Sokhib Temirov, Marjona Makhmudova	
THE IMPORTANCE OF THERMAL ENERGY STORAGE SYSTEMS IN ENHANCING THE EFFICIENCY OF SOLAR DRYERS	110
B. A. Hikmatov, M. S. Mirzaev,	

METHODOLOGY AND PRINCIPLES FOR THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN ADAPTIVE ECONOMIC MODELS OF HIGHER EDUCATION.....	117
O'lmasxo'jayev Zoirxo'ja Abbos o'g'li	
FORECASTING ECONOMIC EFFECTS OF GREEN INNOVATION IN MINING THROUGH COST REDUCTION, ENERGY SAVINGS AND LONG-TERM COMPETITIVENESS.....	122
Kurbanova Mehriniso Nematjanovna	
AN INTELLECTUAL HYBRID MODEL AND FEATURE SPACE FOR NAMED ENTITY RECOGNITION IN KARAKALPAK TEXTS	127
Kalmuratov Bekbosin Kushkinbaevich, Uzakbaev Jangeldi Sabit-uli, Rzambetova Suliwxan Baxtiyarovna	
COMPARATIVE ANALYSIS OF EXISTING METHODOLOGIES FOR ASSESSING THE EFFICIENCY OF LENDING PRACTICE	133
Turdiyev Eralijon Muxtarovich	
STRATEGIC MANAGEMENT OF SERVICE QUALITY: ADAPTING THE GAP MODEL TO SERVICE ENTERPRISES.....	140
Tuxliyev Baxtiyor Maxmaziyayevich	
ORGANISATIONAL AND LEGAL FOUNDATIONS FOR THE DEVELOPMENT OF ISLAMIC FINANCE IN UZBEKISTAN	145
Khodjaev Aziz Shovkatovich	
REGIONAL TRANSMISSION OF MACROECONOMIC SHOCKS AND THE DYNAMICS OF ECONOMIC CONVERGENCE	153
Elyor Nazarov	
PRIORITY DIRECTIONS FOR INCREASING SECTORAL DIVERSIFICATION IN THE ECONOMY OF UZBEKISTAN'S REGIONS	159
Mamarasulov Nozimjon Mamajonovich	
THE ROLE OF STATE STRATEGIC RESERVES IN ENSURING FOOD SECURITY: POLICY EVOLUTION AND REASSESSMENT OF THE MILITARY SUPPLY SYSTEM IN THE CASE OF UZBEKISTAN.....	165
Bazarov Nazirjon Sobirovich	
LOCAL ADAPTATION OF MRA-FW FOR CARDIOVASCULAR RISK ASSESSMENT IN ARAL SEA REGION INPATIENTS.....	170
Uteuliev Niyetbay, Saytov Aralbek, Saytov Kamiljan	
GREEN FINANCE IN UZBEKISTAN: FROM SOVEREIGN BONDS TO FOREIGN DIRECT INVESTMENT IN RENEWABLE ENERGY (2021–2026).....	176
Temirova Nozima Shuhrat qizi	
IMPROVING THE ACCOUNTING OF REVENUE, EXPENSES AND FINANCIAL RESULTS IN PRIVATE HIGHER EDUCATION INSTITUTIONS	182
Saidova Kamolat Farhodovna	
THE IMPACT OF DIGITAL TRANSFORMATION ON SERVICE DELIVERY EFFICIENCY IN LOCAL HIGHER EDUCATION INSTITUTIONS.....	187
Masaidova Marguba Muratovna	
INVESTIGATION OF METAL REFINING DURING ELECTRIC ARC WELDING.....	195
Ermatov Ziyadulla, Rakhmatullaeva Nozima, Galperin Leonid	
STATE AND INSTITUTIONAL SUPPORT FOR THE EXPORT ACTIVITIES OF CONSTRUCTION ENTERPRISES.....	200
Mirzayeva Khulkar Abduladjon kizi	
ECONOMIC DIPLOMACY AS THE EXTERNAL TIER OF INVESTMENT GOVERNANCE: INSTITUTIONAL DESIGN AND IMPLEMENTATION GAPS IN UZBEKISTAN.....	207
Imamov Javokhir	
METHODS FOR IMPROVING THE EFFICIENCY OF PRODUCTION RESOURCE UTILIZATION IN AGRICULTURE	213
Nurxonov Nurkomil Qahramon ugli	
COMPARATIVE ANALYSIS OF MACHINE LEARNING ALGORITHMS FOR AUTOMATIC TOPIC CLASSIFICATION OF KARAKALPAK NEWS TEXTS.....	218
Asenbayev Nurbek Adilbayevich	

JOINT OPTIMISATION OF EXTERNAL-WALL INSULATION THICKNESS AND RADIANT-FLOOR HEAT OUTPUT FOR A SOLAR-CONCENTRATOR-HEATED DWELLING IN THE CLIMATE OF BUKHARA.....	223
Jurabek Kamolov, Sokhib Temirov, Marjona Makhmudova	
IMPROVING THE METHODOLOGY FOR ECONOMIC ANALYSIS OF CONSTRUCTION SERVICE COSTS AT SOCIAL FACILITIES	234
Gapparov Azim Kayumovich	
SPATIOTEMPORAL TRENDS IN WATER QUALITY ALONG THE TASHKENT URBAN REACH OF THE CHIRCHIK RIVER: A PAIRED MONITORING ANALYSIS FOR 2017–2024	241
Ruziev Dilmurod, Matkazyev Dilshod, Begzod Burkhonov, Abdurakhimova Durdona, Yuldosheva Saodat	
ECONOMIC REGULATION OF ENVIRONMENTAL EXTERNALITIES IN CONSTRUCTION INDUSTRY ENTERPRISES: A GRADUATED PAYMENT-SUBSIDY MECHANISM AND FORECASTING APPROACH	251
Xolov Xamza Tojiddinovich	
DIFFERENTIATED APPROACHES TO INCENTIVIZING THE TRANSITION OF SMALL BUSINESSES TO THE FORMAL ECONOMY	260
Yunusov Marat Erkinovich	
THE EFFECTIVENESS OF CORPORATE GOVERNANCE IN BANKS AND ITS IMPACT ON FINANCIAL PERFORMANCE AND RISKS	266
Susanna S. Alieva	

THE EFFECTIVENESS OF CORPORATE GOVERNANCE IN BANKS AND ITS IMPACT ON FINANCIAL PERFORMANCE AND RISKS

Susanna S. Alieva

PhD in Economic Sciences, Associate Professor

Samarkand Institute of Economics and Service, Samarkand, Uzbekistan

E-mail: salieva18@gmail.com

ORCID: 0000-0002-3337-1743

Annotatsiya. O'zbekistonda bank islohotlarining faol bosqichida yirik tijorat banklarining korporativ boshqaruv modeli, xususan, mulkchilik va nazorat tuzilmasining moliyaviy rentabellik hamda risk ko'rsatkichlariga ta'siri baholangan. Tadqiqot tanlanmasida davlat nazoratidagi banklar jami aktivlarning qariyb 68 foizini tashkil etgan. Shu bilan birga, mazkur banklarda aktivlar rentabelligining (ROA) median qiymati 0,6 foizni, nodavlat banklarda esa 4,7 foizni tashkil etgan. Kapital rentabelligining (ROE) median qiymati davlat nazoratidagi banklarda 3,7 foiz, nodavlat banklarda esa 27,5 foiz darajasida qayd etilgan. Nazorat o'zgaruvchilari hisobga olingan regressiya modellari natijalariga ko'ra, davlat nazorati ROA ko'rsatkichining 2,7–4,3 foiz punktga, ROE ko'rsatkichining esa 19–29 foiz punktga past bo'lishi bilan statistik jihatdan ahamiyatli bog'liqlikka ega ($p < 0,01$). Davlat nazoratidagi banklar guruhida 2024-yilda kuzatilgan zarar bilan yakunlangan ikkala holat ham ilgari ajratilgan korporativ kreditlar bo'yicha katta hajmdagi ehtimoliy yo'qotishlar uchun zaxiralar shakllantirilgan davrga to'g'ri kelgan. Davlat nazoratidagi banklarning risk hisobga olingan moliyaviy barqarorlik ko'rsatkichi ($Z = 4,9$) nodavlat banklardagi tegishli ko'rsatkichdan ($Z = 8,8$) qariyb ikki baravar past bo'lgan. Nazorat o'zgaruvchilari orasida kapitallashuv darajasi rentabellik ko'rsatkichlari bilan izchil ijobiy bog'liqlikka ega bo'lgan yagona omil sifatida aniqlangan.

Kalit so'zlar: korporativ boshqaruv, banklar, davlat mulkchiligi, kuzatuv kengashi, moliyaviy samaradorlik, kredit riski, O'zbekiston.

Аннотация. Проведена оценка влияния модели корпоративного управления, характеризующей структурой собственности и контроля, на показатели рентабельности и рисков крупнейших коммерческих банков Узбекистана в период активной фазы банковских реформ. В исследуемой выборке на банки с государственным контролем приходилось около 68% совокупных активов. При этом медианное значение рентабельности активов (ROA) в данной группе составляло 0,6% против 4,7% в негосударственных банках, а медианное значение рентабельности собственного капитала (ROE) — 3,7% против 27,5% соответственно. Результаты регрессионного анализа с учётом контрольных переменных показали статистически значимую отрицательную связь государственного контроля с показателями ROA на уровне 2,7–4,3 процентного пункта и ROE на уровне 19–29 процентных пунктов ($p < 0,01$). Оба случая убыточности банков с государственным контролем, зафиксированные в 2024 году, совпали с формированием значительных резервов под возможные потери по ранее выданным корпоративным кредитам. Показатель финансовой устойчивости с учётом риска ($Z = 4,9$) в банках с государственным контролем оказался приблизительно вдвое ниже соответствующего показателя негосударственных банков ($Z = 8,8$). Среди контрольных переменных уровень капитализации был определён как единственный фактор, демонстрирующий устойчивую положительную связь с показателями рентабельности.

Ключевые слова: корпоративное управление, банки, государственная собственность, наблюдательный совет, финансовая эффективность, кредитный риск, Узбекистан.

Abstract. The relationship between corporate governance models, characterized by ownership and control structures, and the profitability and risk profiles of Uzbekistan's largest commercial banks is examined during the active phase of banking sector reforms. State-controlled banks accounted for approximately 68% of total assets in the study sample. However, their median return on assets (ROA) was 0.6%, compared with 4.7% for non-state banks, while median return on equity (ROE) was 3.7% and 27.5%, respectively. Regression results controlling for other relevant factors indicate that state control is associated with a statistically significant reduction of 2.7–4.3 percentage points in ROA and 19–29 percentage points in ROE ($p < 0.01$). Both loss-making observations among state-controlled banks in 2024 coincided with substantial loan-loss provisioning related to legacy corporate loans. The risk-adjusted financial stability indicator for state-controlled banks ($Z = 4.9$) was approximately half that of non-state banks ($Z = 8.8$). Among the control variables, capitalization was the only factor consistently associated with higher profitability.

Keywords: corporate governance, banks, state ownership, supervisory board, financial performance, credit risk, Uzbekistan.

INTRODUCTION

Banks differ from ordinary joint-stock companies in several respects that make their corporate governance a matter of public interest. Their liabilities consist predominantly of short-term deposits, their assets largely comprise loans characterized by information asymmetry, and their failures may have systemic implications through the payment system. Consequently, the quality of bank governance affects not only shareholders but also depositors, the deposit guarantee fund, and, ultimately, the state budget. The global financial crisis of 2007–2009 highlighted the importance of these considerations for banking regulation. In response, the Basel Committee on Banking Supervision revised its guidance and, in 2015, issued the Corporate Governance Principles for Banks, which place risk oversight at the centre of the board's responsibilities.

In Uzbekistan, this issue has particular characteristics. For much of the period following independence, the banking system developed around state-owned banks that financed state enterprises and government programmes on preferential terms. A. A. Temirov (2022) notes that, at the beginning of the reform period, 13 of the country's 31 banks had state participation and accounted for more than 85% of total banking assets [28]. Presidential Decree No. UP-5992¹ of 12-May-2020 approved the Strategy for Reforming the Banking System for 2020–2025, which established two interrelated objectives: reducing state participation through privatisation and improving corporate governance in banks remaining under state ownership [2]. Law No. ZRU-580² of 5-November-2019, On Banks and Banking Activity, and the Central Bank's regulation On Corporate Governance in Commercial Banks provided the legal framework for implementing these reforms [1].

Existing empirical research on Uzbekistan has primarily examined the determinants of bank profitability [7], non-performing loans [18], and governance-related variables within the state-owned banking segment [27]. Comparative studies examining state-controlled, privately owned domestic, and foreign-controlled banks using recent post-reform data remain relatively limited. The present study seeks to contribute to this area of research.

The aim of the study is to evaluate the effectiveness of corporate governance in Uzbekistan's banks through observable outcomes, particularly financial performance and risk, and to formulate recommendations for further governance reform. The specific objectives are:

To systematise the theoretical and empirical findings of international and Uzbek researchers concerning corporate governance in banks.

To classify Uzbekistan's largest banks according to their governance models and compare their profitability, capitalisation, and incidence of losses during 2024–2025.

To estimate the relationship between governance models and ROA and ROE while controlling for bank size, capitalisation, and year.

To develop policy recommendations concerning privatisation and corporate governance reforms beyond 2025.

LITERATURE REVIEW

The theoretical foundation of corporate governance research is the agency problem between owners and managers, as described by Jensen and Meckling (1976) [19]. In banking institutions, this problem is further complicated by an additional potential conflict of interest between shareholders and creditors. Given relatively limited equity capital and the existence of deposit insurance mechanisms, shareholders may have incentives to assume greater risks, while a portion of the associated losses may be borne by depositors and financial safety-net institutions. Macey and O'Hara (2003) argue that bank directors have broader responsibilities than directors of non-financial companies and should also consider creditors' interests [23]. Levine (2004) identifies two additional characteristics: information asymmetry in banking operations, which may limit market discipline, and extensive regulatory oversight, which can either complement or partially substitute for internal governance mechanisms [22]. In their literature review, De Haan and Vlahu (2016) conclude that conventional corporate governance principles designed primarily to maximise shareholder value require appropriate adaptation when applied to banking institutions [14].

The second strand of the literature examines ownership structures, which represent an important determinant of corporate governance models in emerging markets. La Porta, Lopez-de-Silanes, and Shleifer (2002) report an association between government ownership of banks and differences in financial development and productivity growth across countries [23]. They interpret these findings within the political view of bank ownership, which examines how public policy priorities and institutional decision-making may influence the activities of state-owned banks [23]. Micco, Panizza, and Yañez (2007) find that state-owned banks in developing countries generally exhibit lower profitability and higher operating costs, with these differences becoming more

1 <https://lex.uz/ru/docs/4811037>

2 <https://lex.uz/docs/4581971>

pronounced during election years [27]. Bonin, Hasan, and Wachtel (2005), examining transition economies, report that foreign-owned banks demonstrate relatively high efficiency, while the efficiency differences between government-owned and privately owned domestic banks are not always statistically significant. Their findings also indicate that privatisation outcomes depend on accompanying institutional and managerial improvements [11].

The reviewed literature identifies two recurring empirical patterns: state ownership is frequently associated with differences in bank profitability, while risk-oriented governance mechanisms tend to strengthen risk management. At the same time, governance models primarily focused on shareholder returns may be associated with stronger incentives for risk-taking. Existing empirical evidence concerning Uzbekistan largely covers the period before 2022 or focuses on state-controlled banks. Accordingly, the following hypotheses are formulated and tested using post-reform data:

H1. Banks under state control exhibit lower profitability, measured by ROA and ROE, than privately owned domestic and foreign-controlled banks after controlling for size, capitalisation, and year.

H2. Banks under state control may exhibit differences in risk profiles, as measured by loss incidence, capitalisation, and risk-adjusted solvency.

H3. Higher capitalisation, considered a governance-related financial buffer, is associated with higher returns across all governance models.

RESEARCH METHODOLOGY

The study sample comprises the 20 largest commercial banks in Uzbekistan, ranked by total assets, for the financial years 2024 and 2025. The same 20 banks are included in both years, resulting in a balanced panel dataset containing 40 bank-year observations. Collectively, these banks account for the substantial majority of total banking sector assets. Their aggregate assets amounted to USD 56.8 billion at the end of 2024, compared with USD 59.5 billion for the banking sector as a whole. At the end of 2025, the corresponding figures were USD 72.1 billion and USD 76.9 billion, respectively [30; 31].

Bank-level data on total assets, equity, net income, ROA, and ROE, expressed in USD where applicable, were obtained from the banking sector reviews published in the annual business plans of KDB Bank Uzbekistan for 2025 and 2026. These reviews compile information from the Central Bank of Uzbekistan. In the underlying tables, ROA and ROE are calculated by dividing net income by average total assets and average equity, respectively, where the averages are determined using opening and closing balances. Sector-level aggregates were obtained from the same sources and the banking activity index published by the Centre for Economic Research and Reforms (CERR). Ownership status was determined using banks' official disclosures and publicly available privatisation records. Ipoteka Bank was classified as foreign-controlled in both years, as its acquisition by OTP Bank was completed in 2023 [30; 31].

The empirical analysis was conducted in three stages. First, governance models were compared using medians, means, and measures of dispersion. Differences between state-controlled and non-state banks were assessed using the Mann–Whitney U test, a non-parametric method that does not require the assumption of normally distributed observations.

Second, the relationship between corporate governance models and financial performance was estimated using pooled ordinary least squares (OLS) regression.

The regression model is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 State_i + \beta_2 Foreign_i + \beta_3 InA_{it} + \beta_4 EQA_{it} + \beta_5 Y25_t + \varepsilon_{it}$$

where Y is ROA or ROE of bank i in year t and private domestic banks are the reference group. Standard errors are clustered by bank to allow for correlation of the two observations of each bank. Third, robustness is checked by a median (quantile 0.5) regression and by re-estimating the model without the two extreme loss observations of 2024 (ROA below -5%).

ANALYSIS AND RESULTS

The governance model distinguishes the largest banks into two groups with different financial performance characteristics. State-controlled banks accounted for 68.6% of the sample's total assets in 2024 and 67.7% in 2025, while their reported profitability indicators were comparatively lower. All privately owned domestic banks recorded positive ROA in both years, whereas seven of the nine state-controlled banks reported ROA below 1.5%, including in 2025.

Table 1. Descriptive statistics by governance model³

Model, year	Banks	Share of sample assets, %	ROA median, %	ROA mean, %	ROA std. dev.	ROE median, %	Equity/assets, %	Aggregate net income/assets, %	Loss-making banks
State-controlled, 2024	9	68.6	0.1	-1.19	3.76	1.2	13.9	-0.07	2
State-controlled, 2025	9	67.7	0.9	0.92	0.67	7.3	14.1	0.94	0
Private domestic, 2024	8	21.6	4.8	4.58	2.00	30.0	15.8	3.88	0
Private domestic, 2025	8	22.8	4.5	4.26	2.06	27.5	16.3	3.57	0
Foreign-controlled, 2024	3	9.8	4.8	3.30	3.32	18.4	19.3	0.90	1
Foreign-controlled, 2025	3	9.5	0.7	2.23	3.28	5.3	16.8	1.27	0

When observations from both years are pooled, the differences between state-controlled and non-state banks are substantial and statistically significant for both profitability indicators (Table 2).

Table 2. Comparison of state-controlled and non-state banks, FY2024–FY2025 [30; 31]⁴

Indicator	State-controlled (n = 18)	Non-state (n = 22)	Mann–Whitney p-value
ROA, median, %	0.6	4.7	< 0.001
ROA, mean, %	-0.13	3.97	
ROE, median, %	3.7	27.5	< 0.001
ROE, standard deviation	19.7	11.4	
Equity/assets, mean, %	14.0	16.6	0.059
Loss-making observations	2 of 18	1 of 22	
Z-score (risk-adjusted solvency)	4.9	8.8	

The risk indicators reveal additional differences between the two groups. State-controlled banks have lower equity relative to assets, their ROE exhibits approximately 1.7 times greater dispersion, and their risk-adjusted solvency indicator is approximately half that of non-state banks. The reported Z-score values of 4.9 for state-controlled banks and 8.8 for non-state banks indicate differences in the estimated risk-adjusted solvency measures, subject to the underlying calculation methodology. Sector-level statistics indicate a similar pattern. According to the Central Bank, as of 1-June-2026, the average non-performing loan (NPL) ratio was 4.0% among state-owned banks, compared with 3.2% among privately owned and foreign-controlled banks. State-owned banks accounted for UZS 16.7 trillion of the UZS 23.6 trillion in non-performing loans recorded across the banking system.

Table 3 presents the regression results, with privately owned domestic banks serving as the reference group.

³ Source: Author's calculations. The aggregate net income-to-assets ratio is calculated as the sum of net income for each group divided by the sum of its year-end assets.

⁴ Source: Developed by the author.

Table 3. Relationship between governance models and bank profitability⁵

Variable	(1) ROA, OLS	(2) ROE, OLS	(3) ROA, median regression	(4) ROA, OLS, trimmed	(5) ROE, OLS, trimmed
State	-4.259*** (1.211)	-28.966*** (6.989)	-2.846***	-2.715***	-18.826***
Foreign	-2.246 (1.437)	-14.005 (9.464)	-2.800***	-2.216*	-13.759
lnA	0.339 (0.711)	3.072 (4.273)	-0.371	-0.262	-0.780
EQA	0.295*** (0.051)	0.656** (0.334)	0.300***	0.285***	0.569*
Y25	0.586 (0.596)	4.140 (4.300)	0.083	-0.134	-0.749
Constant	-3.096 (5.488)	-8.166 (33.405)	2.344	1.826	23.908
Observations	40	40	40	38	38
R ²	0.562	0.464		0.744	0.632

Notes: Bank-clustered standard errors are reported in parentheses for columns (1) and (2). Columns (4) and (5) exclude the two observations from 2024 with ROA below -5%. Statistical significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Three main findings emerge from the regression analysis. First, the coefficient on state control is negative and statistically significant at the 1% level across all model specifications. Its estimated association with ROA ranges from -2.7 to -4.3 percentage points, while the corresponding association with ROE ranges from -19 to -29 percentage points. Excluding the two observations with exceptionally large losses reduces the magnitude of the coefficients without eliminating their statistical significance. This suggests that the observed profitability differences are not attributable solely to these two observations and may reflect broader differences in governance and operating conditions.

Second, bank size does not exhibit an independent statistically significant relationship with profitability after controlling for ownership structure. The initially negative correlation between bank size and ROA (Spearman's $\rho = -0.47$) becomes statistically insignificant when ownership is included in the regression model, reflecting the concentration of larger banks within the state-controlled segment.

Third, capitalisation is positively associated with profitability across all model specifications. Each additional percentage point in the equity-to-assets ratio is associated with an increase of approximately 0.3 percentage points in ROA. The coefficient on foreign control is negative but statistically significant only in the median and trimmed regressions, which may reflect the small size and heterogeneous characteristics of the foreign-controlled group.

Accordingly, the empirical findings support H1. H2 is supported by the observed differences in capitalisation, profitability dispersion, risk-adjusted solvency, and asset quality. H3 is also supported by the consistently positive association between capitalisation and financial returns.

The observed profitability differences between state-controlled and non-state banks are broadly consistent with the theoretical framework discussed by La Porta et al. (2002) [23] and the cross-country evidence presented by Micco et al. (2007) [24]. The findings also extend the earlier research of Anvarova and Isakov (2022), covering 2017–2021 [7], and the observations of Omonov (2022) [25] by incorporating more recent post-reform data.

The persistence of profitability differences after five years of reform indicates that the effects of governance changes introduced in state-controlled banks since 2020 may require additional time and complementary institutional measures to become fully reflected in financial performance. Babasyan et al. (2023) identify several relevant structural factors, including the relationship between state-owned banks and state enterprises, preferential financing arrangements, and expectations of capital support [8].

Based on these findings, the following recommendations are proposed.

1. Continue privatisation with the participation of strategic investors. The objective of reducing the number of state-owned banks to four by 2030 is consistent with the direction of the empirical findings. The experience of Ipoteka Bank indicates that changes in ownership structure may require time to translate into improvements in financial performance. Accordingly, privatisation agreements should incorporate commitments to strengthening corporate governance and improving the quality of loan portfolios.

2. Strengthen the supervisory boards of the remaining state-controlled banks. The governance model implemented at SQB, where independent members constitute the majority and chair the supervisory board, may serve as a reference for further institutional improvements. Risk and audit committees should be chaired by independent members with relevant banking expertise, in accordance with the principles of the Basel

5 Source: Developed by the author.

Committee on Banking Supervision (BCBS, 2015) [9].

3. Strengthen the direct accountability of risk management functions to supervisory boards. In line with the findings of Aebi et al. (2012) and Ellul and Yerramilli (2013), the chief risk officer should report directly to the board's risk committee. The institution's risk appetite should be approved and regularly monitored by the supervisory board [5].

CONCLUSION AND RECOMMENDATIONS

The findings indicate that corporate governance effectiveness in Uzbekistan's banking sector is closely associated with ownership and control structures. During 2024–2025, the nine state-controlled banks among the country's 20 largest commercial banks accounted for approximately two-thirds of the sample's total assets. Their median ROA and ROE were 0.6% and 3.7%, respectively, compared with 4.7% and 27.5% among non-state banks.

After controlling for bank size, capitalisation, and year, state control was associated with a reduction of approximately 2.7–4.3 percentage points in ROA and 19–29 percentage points in ROE. These relationships remained statistically significant in median regression and after excluding the two observations with the largest losses. Regarding risk indicators, state-controlled banks exhibited relatively lower capitalisation, greater variability in financial returns, lower risk-adjusted solvency, and, at the sector level, a higher NPL ratio.

The banking reforms implemented during 2020–2025, including the appointment of independent supervisory board members, the introduction of key performance indicators (KPIs) for management, and the initial stages of privatisation, have established an institutional foundation for further improvements in corporate governance. However, the effects of these measures on financial performance have not yet been uniformly reflected across the state-controlled banking segment.

The next stage of reform should combine continued privatisation involving strategic investors with stronger supervisory board independence, enhanced authority for risk committees in banks remaining under state control, clearer separation of policy-oriented lending from commercial banking activities, and more comprehensive disclosure of corporate governance practices. Future research should directly examine supervisory board characteristics and assess the financial performance of privatised banks over longer observation periods.

REFERENCES

1. Law of the Republic of Uzbekistan No. ZRU-580 of 05-11-2019 "On Banks and Banking Activity".
2. Decree of the President of the Republic of Uzbekistan No. UP-5992 of 12-05-2020 "On the Strategy for Reforming the Banking System of the Republic of Uzbekistan for 2020–2025".
3. Regulation "On Corporate Governance in Commercial Banks" / Central Bank of the Republic of Uzbekistan. – Registered by the Ministry of Justice on 30-06-2020, No. 3254.
4. Anvarova M., Isakov O. Impact of Government Ownership on Banks' Profitability: Empirical Evidence from Commercial Banks in Uzbekistan // *Journal of Economics and Financial Analysis*. – 2022. – Vol. 6, No. 1. – P. 37–53. – DOI: <https://doi.org/10.1991/jefa.v6i1.a50>.
5. Babasyan D., Gu Y., Melecky M. Late Banking Transitions: Comparing Uzbekistan to Earlier Reformers // *World Development Perspectives*. – 2023. – Vol. 30. – Article 100493. – DOI: <https://doi.org/10.1016/j.wdp.2023.100493>.
6. Isakov O. Factors Affecting Non-Performing Loans: Empirical Evidence from Commercial Banks in Uzbekistan // *Journal of Economics and Financial Analysis*. – 2024. – Vol. 8, No. 2. – P. 1–21. – URL: <https://ideas.repec.org/a/trp/01jefa/jefa0074.html>.
7. Omonov A. Econometric Analysis of Factors Affecting the Profitability of Commercial Banks // *International Finance and Accounting*. – 2022. – No. 3. – URL: <https://interfinance.tsue.uz/?p=347>.
8. Pulatov Y., Islamov B. Corporate Governance and Bank Profitability: A Fixed Effects Regression Analysis of State-Owned Banks in Uzbekistan // *Scientific Journal of Actuarial Finance and Accounting*. – 2025. – Vol. 5, No. 02. – P. 142–150. – DOI: https://doi.org/10.55439/AFA/vol5_iss02/634.
9. Temirov A. A. Tijorat banklarida korporativ boshqaruvning o'ziga xos xususiyatlari [Corporate Governance in Commercial Banks and Its Features] // *Moliyaviy texnologiyalar*. – 2022. – Vol. 1, No. 1. – P. 47–58.
10. Adams R. B., Mehran H. Bank Board Structure and Performance: Evidence for Large Bank Holding Companies // *Journal of Financial Intermediation*. – 2012. – Vol. 21, No. 2. – P. 243–267.
11. Aebi V., Sabato G., Schmid M. Risk Management, Corporate Governance, and Bank Performance in the Financial Crisis // *Journal of Banking & Finance*. – 2012. – Vol. 36, No. 12. – P. 3213–3226.
12. Anginer D., Demirgüç-Kunt A., Huizinga H., Ma K. Corporate Governance of Banks and Financial Stability // *Journal of Financial Economics*. – 2018. – Vol. 130, No. 2. – P. 327–346.
13. Basel Committee on Banking Supervision. Corporate Governance Principles for Banks [Electronic resource]. – Basel : Bank for International Settlements, 2015. – URL: <https://www.bis.org/bcbs/publ/d328.htm>.
14. Beltratti A., Stulz R. M. The Credit Crisis Around the Globe: Why Did Some Banks Perform Better? // *Journal of Financial Economics*. – 2012. – Vol. 105, No. 1. – P. 1–17.
15. Bonin J. P., Hasan I., Wachtel P. Bank Performance, Efficiency and Ownership in Transition Countries // *Journal of*

- Banking & Finance. – 2005. – Vol. 29, No. 1. – P. 31–53.
16. Caprio G., Laeven L., Levine R. Governance and Bank Valuation // Journal of Financial Intermediation. – 2007. – Vol. 16, No. 4. – P. 584–617.
 17. de Andres P., Vellido E. Corporate Governance in Banking: The Role of the Board of Directors // Journal of Banking & Finance. – 2008. – Vol. 32, No. 12. – P. 2570–2580.
 18. de Haan J., Vlahu R. Corporate Governance of Banks: A Survey // Journal of Economic Surveys. – 2016. – Vol. 30, No. 2. – P. 228–277.
 19. Ellul A., Yerramilli V. Stronger Risk Controls, Lower Risk: Evidence from U.S. Bank Holding Companies // Journal of Finance. – 2013. – Vol. 68, No. 5. – P. 1757–1803.
 20. Erkens D. H., Hung M., Matos P. Corporate Governance in the 2007–2008 Financial Crisis: Evidence from Financial Institutions Worldwide // Journal of Corporate Finance. – 2012. – Vol. 18, No. 2. – P. 389–411.
 21. Fahlenbrach R., Stulz R. M. Bank CEO Incentives and the Credit Crisis // Journal of Financial Economics. – 2011. – Vol. 99, No. 1. – P. 11–26.
 22. Jensen M. C., Meckling W. H. Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure // Journal of Financial Economics. – 1976. – Vol. 3, No. 4. – P. 305–360.
 23. La Porta R., Lopez-de-Silanes F., Shleifer A. Government Ownership of Banks // Journal of Finance. – 2002. – Vol. 57, No. 1. – P. 265–301.
 24. Laeven L., Levine R. Bank Governance, Regulation and Risk Taking // Journal of Financial Economics. – 2009. – Vol. 93, No. 2. – P. 259–275.
 25. Levine R. The Corporate Governance of Banks: A Concise Discussion of Concepts and Evidence. – Washington, DC : World Bank, 2004. – (Policy Research Working Paper No. 3404).
 26. Macey J. R., O'Hara M. The Corporate Governance of Banks // Federal Reserve Bank of New York Economic Policy Review. – 2003. – Vol. 9, No. 1. – P. 91–107.
 27. Micco A., Panizza U., Yañez M. Bank Ownership and Performance: Does Politics Matter? // Journal of Banking & Finance. – 2007. – Vol. 31, No. 1. – P. 219–241.
 28. Pathan S. Strong Boards, CEO Power and Bank Risk-Taking // Journal of Banking & Finance. – 2009. – Vol. 33, No. 7. – P. 1340–1350.
 29. Alieva S. S., Urunova M. G. Theoretical Fundamentals of Improving Financial Health in Enterprises. – 2023.
 30. KDB Bank Uzbekistan. Business Plan 2025: Top 20 Banks of Uzbekistan, Financial Summary for FY2024 [Electronic resource]. – 2025. – Source: Central Bank of the Republic of Uzbekistan. – URL: <https://kdb.uz/storage/business-plans/July2025/qoGRivOJyAX2tEhMm4VY.pdf>.
 31. KDB Bank Uzbekistan. Business Plan 2026: Top 20 Banks of Uzbekistan, Financial Summary for FY2025 [Electronic resource]. – 2026. – Source: Central Bank of the Republic of Uzbekistan. – URL: <https://lists.kdb.uz/storage/business-plans/May2026/4Gz0Dqj4TAdJIMq76sLB.pdf>.
 32. Uzpromstroybank (SQB). Corporate Governance [Electronic resource]. – URL: <https://sqb.uz/en/for-investors/corporate-governance-en/>.
 33. Kun.uz. NBU Named Uzbekistan's Most Profitable Bank in 2024 [Electronic resource]. – 08-02-2025. – URL: <https://m.kun.uz/en/news/2025/02/08/nbu-named-uzbekistans-most-profitable-bank-in-2024>.
 34. Kun.uz. Uzbekistan's Banking Sector Posts Two-Thirds Increase in Net Profit (CERR Banking Activity Index, Q2 2026) [Electronic resource]. – 27-07-2026. – URL: <https://kun.uz/en/news/2026/07/27/uzbekistans-banking-sector-poss-two-thirds-increase-in-net-profit>.
 35. Xinhua via The Star. Uzbekistan's Banking System Posts 3.7-Pct Non-Performing Loan Ratio: Central Bank [Electronic resource]. – 30-06-2026. – URL: <https://www.thestar.com.my/news/world/2026/06/30/uzbekistan039s-banking-system-posts-37-pct-non-performing-loan-ratio-central-bank>.

Proofreader: Zokir ALIBEKOV

Layout and Designer: Oloviddin Sobir ugli

2026. № 10

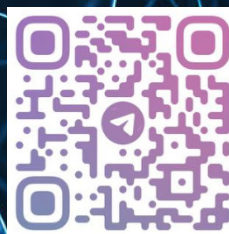
© When materials are reproduced, the INNOVATION SCIENCE AND TECHNOLOGY journal must be cited as the source. Authors are responsible for the accuracy of the information in materials and advertisements published in the journal. Editorial opinions may not always align with those of the authors. Submitted materials will not be returned to the editorial office.

To publish articles in this journal, you may submit articles, advertisements, stories, and other creative materials through the following links. Materials and advertisements are published on a paid basis.

You may subscribe to the journal at any time using the following details. Once subscribed, please send a screenshot or photo of your payment confirmation to our Telegram page @iqtisodiyot_77. Based on this, we will send the latest issue of the journal to your address each month.

“The journal “INNOVATION SCIENCE AND TECHNOLOGY” has been registered by the Agency for Information and Mass Communications under the Administration of the President of the Republic of Uzbekistan from 09.10.2024 under the registration number №390637. License number: C-5669633. PNFL: 30407832680027

Our address: Tashkent city, Yunusobod district, 19th block,
House 17.



Acceptance of articles

Published every
monthly



Directions

Social, economic, political,
technological, scientific



Scopus || Scientific electronic journal specializing in Scopus

CERTIFICATE NUMBER: №390637

**ORDER NUMBER ACCORDING TO
THE LICENSE REGISTER: C-5669633**

CONTACT:



Contact us
+998 50 737 87 88



Telegram channel
t.me/scopus_IST2100



Journal official website
<https://ist-journal.uz/index.php/IST>