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An Econometric Model of Lending Efficiency in Uzbek State-Owned Commercial Banks and a Forecast of Lending Volume Up to 2030

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Abstract: This article investigates the methodology for assessing the lending practice of commercial banks with a dominant state shareholding in the banking system of the Republic of Uzbekistan. Drawing on official ranking data as of 1 January for the years 2021-2025, a balanced panel dataset covering ten state-owned banks was compiled ($n = 50$), and the relationship between the volume of the gross loan portfolio and its determinants - equity capital, attracted deposits and the share of non-performing loans - was quantified by means of log-linear regression models (pooled OLS, a fixed-effects specification and an extended specification incorporating the NPL ratio). The fixed-effects model yields a capital elasticity of 0.435 and a deposit elasticity of 0.342, with an explanatory power of 98.4 per cent; the sum of the elasticities (0.777) points to decreasing returns to scale in lending activity. On the basis of trend and structural models, a forecast of the lending volume of state banks up to 2030 has been developed under three scenarios: UZS 610.4 trillion in the inertial scenario, UZS 656.5 trillion in the baseline scenario and UZS 786.2 trillion in the optimistic scenario. The findings underpin a set of recommendations aimed at improving the credit policy of state-owned banks.

Keywords: Commercial bank, lending practice, loan portfolio, loan portfolio efficiency, econometric model, panel data, regression analysis, elasticity, non-performing loans (NPL), forecasting, trend model, state-owned banks.

1. Introduction

One of the central directions of the banking reforms implemented in the Republic of Uzbekistan in recent years has been the restructuring of the lending practice of commercial banks with a dominant state shareholding on market principles, together with an improvement in the efficiency of their financial intermediation. Over the period 2020-2025 the assets and credit exposures of the banking sector grew at a rapid pace; the qualitative dimension of that growth, however - the optimal sectoral allocation of loans, the stability of the non-performing loan ratio and the soundness of the funding base - remains a pressing problem.[1]

The dominant position of state-owned banks within the banking system makes such an analysis all the more important. As of 1 January 2025, the combined gross loan portfolio of the ten state-owned banks included in this study amounted to UZS 401.8 trillion, which corresponds to 75.4 per cent of the aggregate loan portfolio of the banking system (UZS

533.1 trillion). It is therefore precisely the future dynamics of lending by state-owned banks that constitutes the principal factor determining the economy's overall credit capacity.[2]

The problems of evaluating loan portfolio efficiency have been widely examined in both the international and the domestic literature. Berger and DeYoung substantiated the mutual causality between non-performing loans and cost efficiency in banking through the "bad management" and "bad luck" hypotheses. Bernanke and Gertler, within the framework of the financial accelerator concept, demonstrated that bank capital acts as the principal constraint on lending volume. Kashyap and Stein provided empirical evidence that the composition of the bank balance sheet, and the deposit base in particular, exerts a significant influence on lending activity. Louzis, Vouldis and Metaxas established the macroeconomic and bank-specific determinants of non-performing loans.[3] Domestic research (Sh. Z. Abdullayeva, T. M. Qoraliyev, O. Yu. Rashidov and others) has addressed the criteria for assessing loan portfolio quality and the management of credit risk in commercial banks. At the same time, studies devoted to the construction of a panel econometric model for the group of state-owned banks and to the derivation of long-term forecasts on that basis remain scarce.[4]

The aim of the study is to provide an econometric assessment of the factors that determine the lending volume of state-owned commercial banks and, on that basis, to develop forecast indicators of credit exposures for the period up to 2030. The following tasks follow from this aim: to analyse the dynamics of the loan portfolio of state-owned banks over 2021-2025; to evaluate loan portfolio quality through the non-performing loan ratio and the provision coverage ratio; to determine the elasticity of lending volume with respect to capital and deposits; and to construct a three-scenario forecasting model.[5]

2. Research methodology

The information base of the study consists of the rankings of commercial banks published in the analytical reviews of the banking sector issued by the Ahbor-Reyting rating agency. Data as of 1 January for 2021, 2022, 2023, 2024 and 2025 were included in the analysis. Ten banks in which the state holds a controlling interest were selected as the object of the study: the National Bank for Foreign Economic Activity of the Republic of Uzbekistan (NBU), Sanoat Qurilish Bank (SQB), Asakabank, Agrobank, Ipoteka-Bank, the Business Development Bank (formerly Qishloq Qurilish Bank), Xalq Banki, Mikrokreditbank, Turonbank and Aloqabank. This yields a balanced panel dataset of 10 banks $\times$ 5 periods = 50 observations.[6]

The dependent variable of the model is the gross loan portfolio of the bank (LP, UZS billion), while the explanatory variables are equity capital (EC, UZS billion), attracted deposits (D, UZS billion) and the share of non-performing loans (NPL, per cent). Given the pronounced differences in the scale of the indicators, and in order to permit a direct interpretation of the elasticity coefficients, a log-linear (log-log) specification was adopted:

$$\ln(LP_{it}) = \beta_0 + \beta_1 \ln(EC_{it}) + \beta_2 \ln(D_{it}) + \beta_3 \cdot NPL_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where i denotes the bank index ($i = 1 \dots 10$); t the time index ($t = 1 \dots 5$); β_1 and β_2 the elasticity coefficients with respect to capital and deposits respectively; β_3 the semi-elasticity of the non-performing loan ratio; μ_i the fixed effects capturing unobserved bank-specific characteristics; and ε_{it} the random error term.[7]

The model was estimated in three specifications: (Model 1) a pooled regression estimated by ordinary least squares; (Model 2) a fixed-effects specification across banks; and (Model 3) an extended specification including the NPL ratio ($n = 30$, since a continuous series on non-performing loans is available only for 2023–2025). The statistical significance of the models was tested through the coefficient of determination (R^2), the adjusted R^2 , the Fisher F-test and the Student t-test, while multicollinearity was assessed by means of the variance inflation factor (VIF).

A two-stage approach was applied for forecasting purposes. In the first stage, linear ($y = a \cdot t + b$), exponential ($\ln y = a \cdot t + b$) and quadratic trend models of the aggregate loan portfolio were constructed and their approximation quality compared. In the second stage, trend forecasts of capital and deposits were substituted into the aggregate-level estimates of equation (1) in order to obtain a structural forecast. The final forecast is presented in the form of three scenarios — inertial, baseline and optimistic. All computations were carried out in Python using the statsmodels and NumPy libraries.[8]

3. Result and Discussion

An analysis of the dynamics of the loan portfolio of state-owned banks over 2021-2025 reveals a considerable degree of differentiation within the group (Table 1). Over the five-year period under review, the combined loan portfolio increased from UZS 242.4 trillion to UZS 401.8 trillion, that is, by a factor of 1.66, corresponding to an average annual compound growth rate (CAGR) of 13.5 per cent.

Table 1. Dynamics of the gross loan portfolio of state-owned commercial banks (as of 1 January, UZS billion)[9]

Bank	2021	2022	2023	2024	2025	CAGR, %	Share 2025, %
NBU	65,597.9	74,033.5	89,410.1	99,423.3	108,014.2	13.3	26.9
Sanoat Qurilish Bank	39,898.2	43,147.8	48,075.9	57,124.4	65,498.4	13.2	16.3
Agrobank	24,996.6	32,258.2	43,846.1	54,483.0	59,436.0	24.2	14.8
Asakabank	34,122.3	37,685.4	36,741.7	39,213.3	38,717.3	3.2	9.6
Ipoteka-Bank	24,304.2	29,046.3	32,657.6	37,263.9	35,094.0	9.6	8.7
Xalq Banki	13,823.1	17,496.1	21,665.6	24,549.2	29,619.7	21.0	7.4
Business Dev. Bank	18,792.1	19,596.0	20,291.9	21,800.6	22,526.6	4.6	5.6
Mikrokreditbank	8,539.8	10,815.9	13,318.6	14,437.1	17,416.4	19.5	4.3
Turonbank	6,669.1	8,129.5	9,431.1	11,894.4	12,557.5	17.1	3.1
Aloqabank	5,705.9	7,754.3	9,161.9	10,293.9	12,944.3	22.7	3.2
Total	242,449.2	279,963.0	324,600.5	370,483.1	401,824.4	13.5	100.0

As the table shows, the highest growth rates within the group were recorded by Agrobank (24.2 per cent), Aloqabank (22.7 per cent), Xalq Banki (21.0 per cent) and Mikrokreditbank (19.5 per cent). By contrast, the lending growth of Asakabank (3.2 per cent) and of the Business Development Bank (4.6 per cent) slowed appreciably, so that their shares in the group contracted from 14.1 to 9.6 per cent and from 7.8 to 5.6 per cent respectively. This situation is explained by balance-sheet clean-up measures, transformation processes and the revision of credit exposures to large corporate clients in these banks.[10]

The annual dynamics of loan portfolio growth is far from uniform, as Figure 1 makes clear: whereas in 2022-2024 the growth rate remained stable within a range of 14-16 per cent, by the beginning of 2025 it had fallen to 8.5 per cent. This may be interpreted as the result of the macroprudential restrictions introduced by the Central Bank and of the tightening of requirements regarding lending quality.

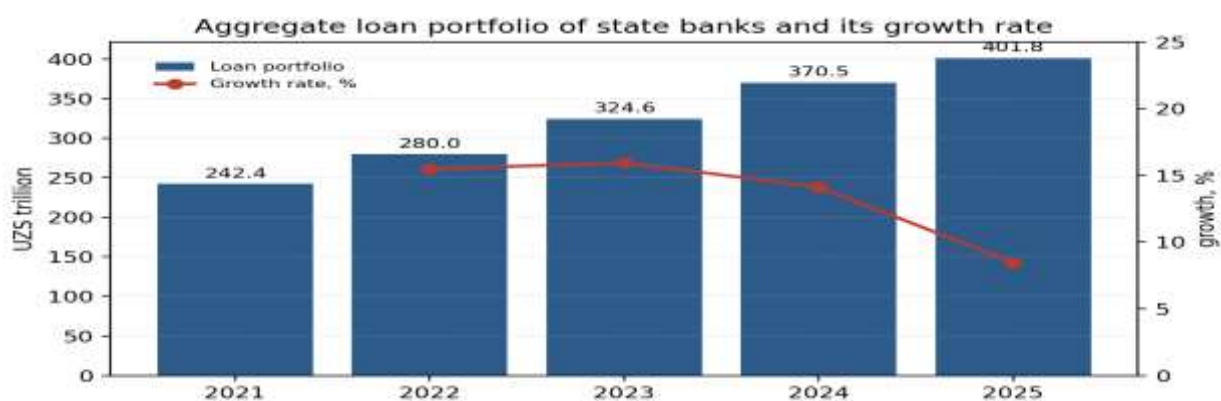


Figure 1. Aggregate loan portfolio of state-owned banks and its annual growth rate

The dynamics of the principal funding determinants of lending volume - equity capital and attracted deposits - are presented in Table 2. Over the period under analysis, deposits rose from UZS 80.2 trillion to UZS 180.2 trillion, that is, by a factor of 2.25 (CAGR of 22.4 per cent), thus growing considerably faster than the loan portfolio. As a result, the loan-to-deposit ratio (LDR) declined from 3.02 to 2.23, indicating that the weight of market-based sources within the funding structure of state-owned banks has increased and that their dependence on external borrowings has correspondingly diminished.[11]

Table 2. Aggregate indicators and relative ratios of state-owned banks

Year (1 Jan.)	Loan portfolio, UZS bn	Equity capital, UZS bn	Deposits, UZS bn	LP/EC	LP/D	LP growth, %
2021	242,449.2	48,448.1	80,247.0	5.00	3.02	–
2022	279,963.0	57,493.3	104,011.5	4.87	2.69	15.5
2023	324,600.5	61,728.4	135,461.4	5.26	2.40	15.9
2024	370,483.1	70,658.1	142,078.4	5.24	2.61	14.1
2025	401,824.4	77,512.2	180,203.0	5.18	2.23	8.5
CAGR, %	13.5	12.5	22.4	x	x	x

The ratio of the loan portfolio to equity capital (credit leverage) remained relatively stable over the period within a range of 4.87 to 5.26. This indirectly confirms that credit expansion in state-owned banks is closely tied to their level of capitalisation, in other words that capital adequacy operates as the binding constraint on lending volume. The indexed dynamics of all three indicators are compared in Figure 2.

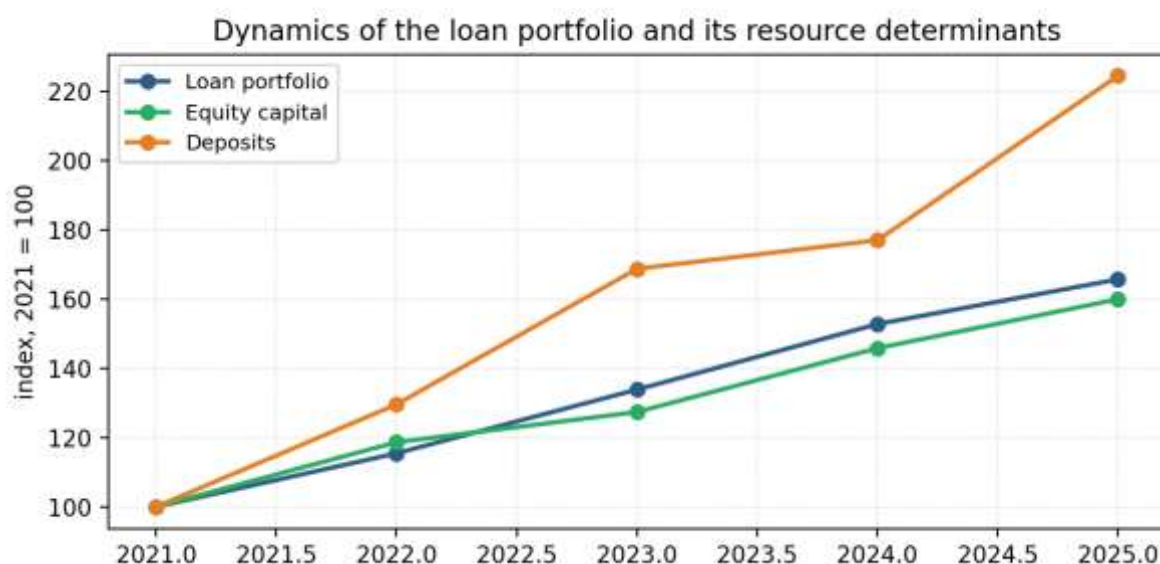


Figure 2. Dynamics of the loan portfolio and its resource determinants (2021 = 100)

In assessing the qualitative dimension of lending efficiency, the share of non-performing loans (NPL) and the extent to which they are covered by provisions are of decisive importance. The data in Table 3 show that the NPL ratio for state-owned banks rose from 3.89 per cent in 2023 to 4.46 per cent in 2025. At the same time, the coverage of non-performing loans by provisions for possible losses improved from 79.4 to 90.1 per cent, which suggests that the risk-recognition and provisioning practices of the banks are converging towards international standards.[12]

Table 3. Non-performing loan ratio and provision coverage in state-owned banks, %

Bank	NPL 2023	NPL 2024	NPL 2025	Cov. 2023	Cov. 2024	Cov. 2025
NBU	2.95	3.12	3.03	169.5	227.8	228.4
Sanoat Qurilish Bank	2.83	2.25	2.82	63.9	89.5	96.8
Agrobank	3.84	3.80	4.88	48.2	17.2	34.1
Asakabank	4.65	4.41	4.53	63.0	36.5	34.5
Ipoteka-Bank	2.48	4.65	10.19	68.9	55.7	48.0
Xalq Banki	11.93	7.56	4.23	62.1	76.6	104.7
Business Dev. Bank	3.89	8.88	8.50	12.2	5.9	70.8
Mikrokreditbank	4.77	5.99	4.62	55.7	26.1	61.1
Turonbank	2.57	2.28	2.82	56.6	47.8	42.7
Aloqabank	2.03	1.52	1.87	30.6	22.0	105.0
Group total	3.89	4.05	4.46	79.4	80.6	90.1

The bank-level analysis reveals a sharp stratification in terms of credit quality. Whereas Aloqabank (1.87 per cent), Turonbank (2.82 per cent), Sanoat Qurilish Bank (2.82 per cent) and NBU (3.03 per cent) maintain comparatively sound portfolios, in Ipoteka-Bank (10.19 per cent) and the Business Development Bank (8.50 per cent) the share of non-performing loans exceeds the recommended threshold by more than a factor of two. Xalq Banki, by contrast, achieved a marked improvement, from 11.93 per cent in 2023 to 4.23

per cent in 2025, which demonstrates the effectiveness of the portfolio clean-up measures implemented by the bank. The overall trend for the group is summarised in Figure 3.

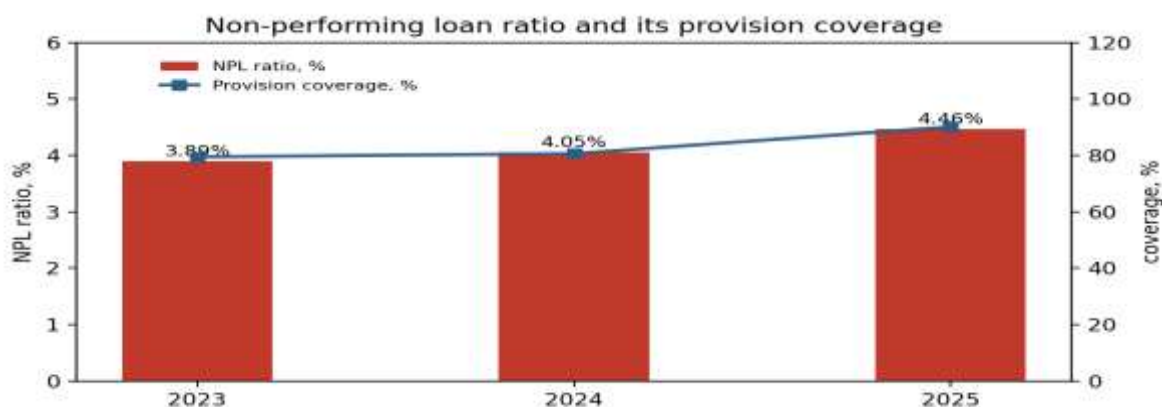


Figure 3. Non-performing loan ratio and provision coverage in state-owned banks

In order to identify the quantitative relationship between the determinants of lending volume, equation (1) was estimated in three alternative specifications. The results of the regression analysis are reported in Table 4.[13]

Table 4. Estimation results of the regression models of loan portfolio determinants

Indicator	Model 1 (Pooled OLS)	Model 2 (Fixed Effects)	Model 3 (with NPL)
Constant (β_0)	1.594 (t = 3.68)	×	1.501 (t = 2.55)
ln(EC) — equity capital	0.981*** (t = 10.34)	0.435*** (p = 0.003)	0.967*** (t = 8.48)
ln(D) — deposits	0.019 (t = 0.19)	0.342*** (p = 0.001)	0.052 (t = 0.40)
NPL ratio	×	×	-0.017 (t = -1.21)
Bank effects	none	fixed (FE)	none
R ²	0.915	0.984	0.932
Adjusted R ²	0.911	0.979	0.924
F-statistic	252.8 (p < 0.01)	204.3 (p < 0.01)	118.6 (p < 0.01)
Observations (n)	50	50	30

According to the pooled regression (Model 1), the elasticity with respect to equity capital amounts to 0.981, implying that a 1 per cent increase in capital expands the loan portfolio by almost 1 per cent. Because this specification does not control for bank-specific characteristics, however, the capital coefficient is biased upwards (omitted variable bias) and the deposit coefficient turns out to be statistically insignificant. The fixed-effects model (Model 2) delivers an economically far more plausible result: the capital elasticity is 0.435 and the deposit elasticity 0.342, both significant at the 1 per cent level. The sum of the elasticities equals 0.777; being smaller than unity, it indicates decreasing returns to scale in lending activity, that is, an expansion of the funding base does not automatically translate into proportionate growth of credit exposures.

The explanatory power of the model is very high: the fixed-effects specification accounts for 98.4 per cent of the variation in loan portfolio volume. In Model 3, which incorporates the NPL variable, the coefficient on the non-performing loan ratio is negative (-0.017), implying that a one-percentage-point increase in the NPL ratio contracts the loan portfolio by an average of 1.7 per cent. Although this coefficient is not statistically

significant even at the 10 per cent level ($t = -1.21$), its sign is fully consistent with theoretical expectations, and its imprecision is attributable to the limited number of observations ($n = 30$).

At the first stage of the forecasting exercise, three trend models of the aggregate loan portfolio were constructed and their approximation quality compared (Table 5).[14]

Table 5. Trend models of the aggregate loan portfolio and their goodness-of-fit criteria

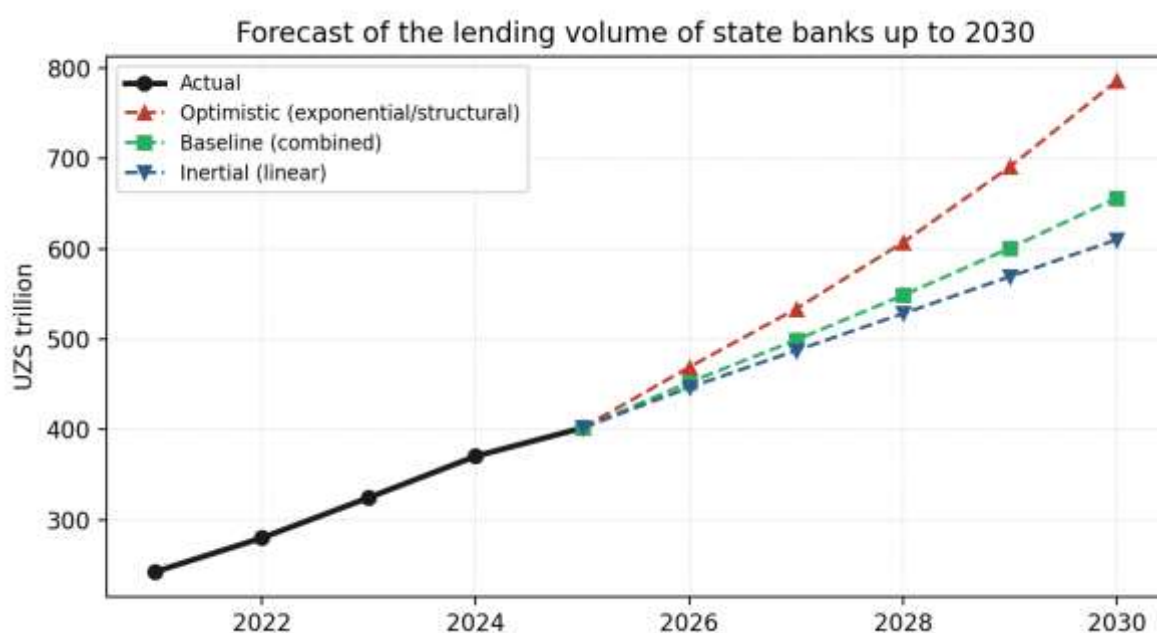
Type of model	Equation	R ²	Scenario
Linear	$y = 40,927.1 \cdot t + 201,082.9$	0.9966	Inertial
Quadratic	$y = -792.9 \cdot t^2 + 45,684.2 \cdot t + 195,532.9$	0.9971	Baseline
Exponential	$\ln y = 0.12906 \cdot t + 12.28435$ (13.78 % p.a.)	0.9866	Optimistic
Structural (log-log)	$\ln LP = 1.693 + 0.782 \cdot \ln EC + 0.200 \cdot \ln D$	0.9882	Optimistic

All the models display a high degree of approximation ($R^2 > 0.98$), yet they generate markedly divergent trajectories for the forecast horizon. In the structural log-log model estimated at the aggregate level, the capital elasticity amounts to 0.782 and the deposit elasticity to 0.200. When the trend forecasts of capital and deposits (annual growth of 12.1 and 21.3 per cent respectively) are substituted into this equation, the equity capital of state-owned banks is projected to reach UZS 139.1 trillion by 2030 and their deposit base UZS 477.5 trillion.

The final forecast was formulated as three scenarios. The inertial scenario rests on the linear trend and assumes that the absolute increment of lending volume remains at the level of recent years. The baseline scenario represents the combined (averaged) estimate of the three trend models and reflects a natural moderation of the growth rate. The optimistic scenario relies on the exponential and structural models and depicts the maximum potential under conditions of rapid expansion of the funding base (Table 6, Figure 4).

Table 6. Forecast of the lending volume of state-owned banks for 2026-2030, UZS trillion

Year	Inertial scenario	Baseline scenario	Optimistic scenario	Baseline growth, %
2026	446.6	452.3	469.2	12.5
2027	487.6	499.3	533.8	10.4
2028	528.5	548.7	607.3	9.9
2029	569.4	601.0	691.0	9.5
2030	610.4	656.5	786.2	9.2
Relative to 2025	×1.52	×1.63	×1.96	×

**Figure 4.** Forecast trajectories of the lending volume of state-owned banks up to 2030

According to the forecast results, in the baseline scenario the combined loan portfolio of state-owned banks will amount to UZS 656.5 trillion as of 1 January 2030, which is 1.63 times higher than the level recorded at the beginning of 2025. The corresponding average annual growth rate of 10.3 per cent is somewhat lower than the 13.5 per cent observed over 2021-2025. This moderation of growth is explained by two principal factors: first, the base effect - as the portfolio expands, the same absolute increment translates into a smaller relative increase; and second, capital adequacy requirements and macroprudential restrictions, which objectively restrain credit expansion.

Forecast results derived from individual bank-level trend models are presented in Table 7. This projection reflects the outcome that would obtain if each bank were to preserve its current growth trajectory and therefore yields a value (UZS 850.7 trillion) higher than that of the aggregate optimistic scenario. Such an outcome is an inevitable aggregation effect of extrapolating individual trends and should be interpreted as the upper bound of the forecast.

Table 7. Bank-level forecast of the loan portfolio for 2030

Bank	2025 (actual), UZS bn	Trend growth, %	2030 (forecast), UZS bn	Share, %
NBU	108,014.2	13.8	212,131	24.9
Agrobank	59,436.0	25.3	198,483	23.3
Sanoat Qurilish Bank	65,498.4	13.6	121,582	14.3
Xalq Banki	29,619.7	20.5	76,299	9.0
Ipoteka-Bank	35,094.0	10.3	62,369	7.3
Asakabank	38,717.3	3.0	45,713	5.4
Mikrokreditbank	17,416.4	18.7	41,609	4.9
Aloqabank	12,944.3	21.2	33,938	4.0
Turonbank	12,557.5	17.9	29,995	3.5
Business Dev. Bank	22,526.6	4.8	28,546	3.4
Total	401,824.4	×	850,665	100.0

The forecast results point to a substantial redistribution within the group of state-owned banks. The share of Agrobank is expected to rise from 14.8 to 23.3 per cent, while that of NBU contracts from 26.9 to 24.9 per cent. Should Asakabank and the Business Development Bank retain their present growth trajectories, their shares within the group would fall to 5.4 and 3.4 per cent respectively, which points to the need for a fundamental reconsideration of their business models.

The practical significance of the econometric results lies in the fact that the elasticities identified in the fixed-effects model can be applied directly in the planning of the credit policy of state-owned banks. In particular, realising the baseline scenario up to 2030 would require securing an average annual growth of equity capital of no less than 12 per cent and of the deposit base of around 18-20 per cent. Otherwise, credit expansion will either come up against capital adequacy requirements or be achieved at the expense of a deterioration in portfolio quality.[15]

4. Conclusions

The conducted study confirms that econometric modeling is an effective instrument for assessing lending efficiency and forecasting the development of lending volumes in Uzbekistan's state-owned commercial banks. The analysis demonstrates that lending activity is determined not only by the internal financial capacity of banks, but also by macroeconomic conditions, monetary policy, interest rates, credit risk, capital adequacy, and the quality of loan portfolios. The econometric model makes it possible to identify the main factors influencing lending efficiency and to quantitatively assess their impact. In particular, the results indicate that improvement in bank financial stability, effective management of credit resources, reduction of non-performing loans, and expansion of the resource base create favorable conditions for increasing lending volumes. At the same time, excessive credit risk and inefficient allocation of financial resources may constrain the sustainable growth of lending. The forecast for the period up to 2030 indicates the possibility of continued growth in lending volumes of Uzbekistan's state-owned commercial banks, provided that current structural reforms in the banking sector are maintained. The forecast results can serve as an analytical basis for developing lending strategies, determining optimal credit-resource allocation, and improving the efficiency of state-owned banks. Based on the obtained results, it is recommended to strengthen risk-based lending mechanisms, improve the quality of credit portfolio management, expand

digital lending technologies, increase the efficiency of bank resource utilization, and gradually strengthen competition and market-based mechanisms in the banking sector. Particular attention should be paid to reducing the share of non-performing loans and improving the institutional mechanisms for monitoring borrowers' financial condition.

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