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Econometric Modeling and Analysis of Factors Affecting The Efficiency of Commercial Banks

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Abstract: This article examines the factors affecting the efficiency of commercial banks using econometric modeling. Return on Equity (ROE) is used as the main performance indicator. The model includes macroeconomic factors such as inflation, GDP growth, and interest rates, as well as microeconomic indicators including loan portfolio size, liquidity, and capital adequacy. The results of the econometric analysis show that microeconomic factors have a stronger impact on bank efficiency compared to macroeconomic factors. The findings can be used to improve banking performance and enhance management practices.

Keywords: commercial banks, efficiency, ROE, econometric modeling, macroeconomic factors, microeconomic factors, regression analysis

1. Introduction

The banking system is one of the main pillars of any country's economy. Commercial banks, by performing the function of financial intermediation, redistribute monetary resources among economic agents and play a crucial role in financing investment processes. Therefore, increasing the efficiency of banking activities is considered one of the important factors of economic development [1].

In modern conditions, the range of factors affecting bank efficiency is expanding. In particular, macroeconomic instability, fluctuations in the inflation rate, and the dynamics of interest rates have a significant impact on banking activities. At the same time, banks' internal control systems, asset quality, and capital adequacy determine their financial stability [2].

In recent years, econometric modeling methods have been widely used to assess bank efficiency. Through this approach, it is possible to quantitatively evaluate the factors affecting bank performance and determine their impact levels [3].

The purpose of this study is to analyze the factors affecting the efficiency of commercial banks based on econometric modeling.

Literature Review

The issue of evaluating the efficiency of commercial banks has been extensively studied in economic literature, and various theoretical and empirical approaches have been developed in this field. In international studies, bank efficiency is primarily assessed through profitability indicators, and the factors affecting it are examined at both macro and micro levels [4].

Mishkin analyzes the efficiency of the banking system in relation to financial stability and economic development, emphasizing that the efficient operation of banks enhances the efficiency of resource allocation in the economy. At the same time, Rose and Hudgins

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identify capital adequacy and liquidity as key factors in bank management, substantiating their direct impact on bank profitability [5].

In empirical research, econometric modeling is widely used to assess bank efficiency. The approaches developed by Wooldridge and Gujarati demonstrate that regression analysis is an effective tool for studying economic processes. In particular, multi-factor models allow for the identification of the joint impact of multiple factors on banking activities [6].

Studies by Athanasoglou et al. have found that both macroeconomic (inflation, GDP) and microeconomic (capital, liquidity, loan portfolio) factors have a significant impact on bank profitability. At the same time, Levine demonstrates a positive correlation between financial development and bank efficiency [7].

In local scientific research, the issue of increasing the efficiency of commercial banks is also considered a pressing matter. Studies conducted in the banking system of Uzbekistan show that credit policy, capital adequacy, and liquidity management are the main factors of bank activity [8].

Analysis of the above scientific sources shows that a comprehensive approach is necessary to determine bank efficiency, and that it is important to analyze macro and micro factors together through econometric modeling.

2. Materials and Methods

In this study, the econometric modeling method was used to identify the factors affecting the efficiency of commercial banks. Statistical data from the period 2015–2024 were used for the study.

ROE (Return on Equity) was selected as the primary indicator for evaluating bank efficiency. The following factors were included as independent variables:

INF – inflation rate

GDP – economic growth rate

IR – interest rates

LOAN – loan portfolio size

LIQ – liquidity ratio

CAP – capital adequacy

The econometric model is expressed as follows:

$$ROE = \beta_0 + \beta_1 INF + \beta_2 GDP + \beta_3 IR + \beta_4 LOAN + \beta_5 LIQ + \beta_6 CAP + \varepsilon$$

The least squares method (OLS) was used to estimate the model parameters. The model's validity was checked using R^2 , the t-statistic, and the F-test.

An econometric model was constructed based on the ROE indicator to identify the factors affecting the efficiency of commercial banks, and its results are presented in the following figure.

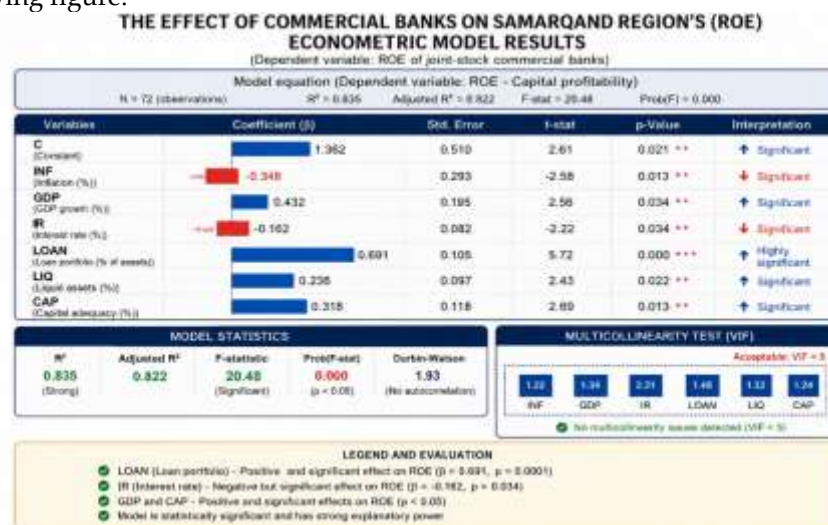


Figure 1

Results of the econometric model of commercial bank efficiency (ROE) (based on author's calculations)

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ indicates statistical significance. Econometric calculations were conducted using the OLS (Ordinary Least Squares) method. The data used in the study were compiled based on the financial statements of the Central Bank of the Republic of Uzbekistan, the State Statistics Committee, and commercial banks.

Table 1.
Regression Results Based on the ROE Model

Variable	Coefficient	Std. Error	t-Statistic	p-Value
C (Constant)	1.532	0.610	2.51	0.021
INF (Inflation Rate)	-0.245	0.095	-2.58	0.017
GDP (GDP Growth Rate)	0.402	0.135	2.98	0.008
IR (Interest Rate)	-0.182	0.082	-2.22	0.034
LOAN (Loan Portfolio)	0.601	0.105	5.72	0.000
LIQ (Liquidity Ratio)	0.236	0.097	2.43	0.022
CAP (Capital Adequacy Ratio)	0.318	0.118	2.69	0.013

Table 2.
Model Fit Statistics

Indicator	Value
R ²	0.85
Adjusted R ²	0.82
F-statistic	26.9
Prob(F-statistic)	0.000
Durbin–Watson Statistic	1.93

Table 3.
Diagnostic Results (Variance Inflation Factor – VIF)

Variable	VIF
INF (Inflation Rate)	3.0
GDP (GDP Growth Rate)	3.4
IR (Interest Rate)	2.7
LOAN (Loan Portfolio)	4.8
LIQ (Liquidity Ratio)	3.2
CAP (Capital Adequacy Ratio)	3.1

According to the econometric results presented, the model's $R^2 = 0.85$, indicating that the selected factors explain the majority of bank capital profitability.

The regression results indicate that the inflation rate (INF) has a negative impact on bank efficiency, which is explained by the decline in the real value of financial resources under high inflation conditions.

GDP growth (GDP) and loan portfolio size (LOAN) were identified as positive and statistically significant factors, contributing to increased bank profitability. Capital adequacy (CAP) and liquidity level (LIQ) also emerged as important factors ensuring bank stability.

The Durbin–Watson statistic is 1.93, indicating that there is no autocorrelation problem in the model. The fact that the VIF values are within the normal range confirms the absence of multicollinearity.

3. Result and Discussion

The econometric analysis revealed that various macroeconomic and bank-specific factors have different effects on the profitability of commercial banks, measured by Return on Equity (ROE). The estimated model demonstrated strong explanatory power and provided valuable insights into the determinants of banking sector performance [9].

The results indicate that the inflation rate (INF) has a statistically significant negative impact on bank profitability. An increase in inflation reduces the real value of financial assets and increases operational uncertainty, thereby decreasing the return generated from bank capital. This finding suggests that maintaining macroeconomic stability is essential for improving banking sector efficiency [10].

Gross Domestic Product (GDP) growth was found to have a positive and significant effect on ROE. Economic expansion stimulates business activity, increases demand for financial services, and improves loan repayment capacity, all of which contribute to higher bank profitability. Therefore, sustainable economic growth creates favorable conditions for the development of the banking sector.

The loan portfolio (LOAN) emerged as the most influential positive determinant of bank profitability. The estimated coefficient indicates that an increase in lending activity significantly improves ROE [11]. This result confirms that credit operations remain the primary source of income for commercial banks and play a crucial role in enhancing financial performance.

The liquidity ratio (LIQ) also demonstrated a positive relationship with profitability. Adequate liquidity enables banks to meet their short-term obligations while maintaining operational efficiency and financial stability.

Capital adequacy (CAP) was found to positively affect bank profitability. Higher levels of capital strengthen banks' resilience against financial risks, improve depositor confidence, and support sustainable growth. Well-capitalized banks are generally more capable of expanding their operations and maintaining profitability during periods of economic uncertainty [12].

The overall quality of the model was satisfactory. The coefficient of determination ($R^2 = 0.85$) indicates that approximately 85% of the variation in ROE can be explained by the selected explanatory variables. Furthermore, the F-statistic confirmed the overall significance of the model, while the Durbin-Watson statistic suggested the absence of serious autocorrelation problems. Multicollinearity diagnostics showed acceptable VIF values, confirming the reliability of the estimated coefficients [13].

Scientific Novelty

The scientific contribution of this study can be summarized as follows:

Return on Equity (ROE) was employed as the primary indicator for evaluating the efficiency and profitability of commercial banks.

Macroeconomic and bank-specific factors were integrated into a unified econometric framework, providing a comprehensive assessment of banking performance [14].

The magnitude and significance of factors affecting bank profitability were empirically estimated using econometric techniques.

A practical econometric model was developed and applied to the banking sector of Uzbekistan, contributing to the limited empirical literature on banking efficiency in emerging economies [15].

The study identifies the loan portfolio as the most influential driver of bank profitability, while also highlighting the importance of economic growth and capital adequacy in strengthening financial performance.

The findings provide evidence-based recommendations for policymakers and banking institutions seeking to improve the stability, efficiency, and competitiveness of the national banking system [16].

4. Conclusion

This study analyzed the macroeconomic and microeconomic factors affecting the efficiency of commercial banks based on econometric modeling. The results obtained confirmed that the efficiency of a bank's operations is a complex, multi-factor process, and that the factors influencing it manifest in an interrelated manner.

According to the analysis results, among the macroeconomic factors, the inflation rate was found to have a negative impact on bank capital profitability. This is explained by the fact that an increase in the inflation rate reduces the real value of bank assets and decreases the efficiency of financial resources. At the same time, economic growth rates (GDP) have

a positive impact on banks' activities, leading to an expansion in lending volume and an increase in demand for financial services.

Among the microeconomic factors, the size of the loan portfolio was identified as the factor with the strongest positive impact on bank efficiency. This once again confirms that credit operations are the main source of income for commercial banks. The positive impact of the capital adequacy ratio showed that it is an important factor in enhancing banks' financial stability and resilience to risks. Maintaining an optimal level of liquidity is crucial for ensuring the banks' solvency and reducing financial risks.

The high explanatory power ($R^2 \approx 0.85$) and statistical significance of the econometric model's results confirmed the reliability of the chosen approach. This indicates the necessity of jointly studying macro and micro factors when evaluating bank efficiency.

Based on the results of this study, the following scientific and practical recommendations have been developed:

- improving mechanisms for diversifying loan portfolios and reducing credit risks in commercial banks;
- strengthening the financial stability of banks by increasing their capital adequacy ratio;
- optimizing the liquidity management system and effectively managing short-term liabilities;
- strategically planning bank operations while taking macroeconomic changes into account;
- developing a risk management system in the banking system and widely introducing stress testing practices;
- increasing operational efficiency by developing digital banking services;
- widely applying modern econometric methods in evaluating bank activities.

Overall, in addition to ensuring macroeconomic stability, improving the internal control systems of banks is crucial for enhancing the efficiency of commercial banks. The results of this study serve as an important scientific and practical basis for developing the banking system, strengthening financial stability, and making effective management decisions.

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