Analysis of Factors Influencing the Profitability of Korean Commercial Banks

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Abstract

Purpose – Based on the study of domestic and foreign literature, according to the actual situation of listed commercial banks in Korea, the profitability index of the explained variable takes the return on total assets as an alternative index, and selects the loan-deposit ratio, non-performing loan ratio, capital adequacy ratio, total assets and cost income as explanatory variables. A random effects model was built using data from 12 Korean commercial banks from 2015 to 2023.

Design/Methodology/Approach – Firstly, it makes a descriptive analysis of the current status and development trend of profitability index and its influencing factors. Then, the unit root test of the variable sequence is carried out by using EViews 7.2 software. After the indexes that failed the stationarity test were corrected, the most appropriate regression analysis model was selected by F-test and Hausman test. Based on the research of Chinese and foreign literatures and the actual situation of listed companies of Korean commercial banks, the profitability index of explained variables takes return on total assets as an alternative index, and selects loan-to-deposit ratio, non-performing loan ratio, capital adequacy ratio, total assets and cost income as explanatory variables. A random effects model was built using data from 12 commercial banks from 2015 to 2023.

Findings – The results show that operating efficiency, liquidity and capital adequacy ratio have a significant positive impact on the profitability of Korean commercial banks, which shows that the profitability of Korean commercial banks will increase with the improvement of operating efficiency, liquidity and capital adequacy ratio.

Research Implications – Therefore, in order to improve the profitability of commercial banks, the following aspects can be considered: In terms of operation efficiency, the operation efficiency and profitability of commercial banks can be improved by adjusting the organizational structure, strengthening the operation and management of employees, improving the assessment mechanism and strengthening the construction of the financial system of commercial banks. In terms of capital adequacy ratio, the asset adequacy ratio can be improved by increasing capital and reducing risk-weighted assets. The specific measures include expanding channels to raise capital, effectively controlling and handling non-performing assets, and establishing a sound risk management system to improve the profitability of commercial banks. In terms of liquidity, the establishment of professional risk management organization system and risk management organization system can have a positive impact on the profitability of commercial banks.

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Ⅰ. introduction

Korean commercial banks are special financial institutions in South Korea, whose main business is to operate currency. The quality of their operations will directly affect the economic development of the entire country. If the banking system is healthy, efficient, and has sustained profitability, commercial banks can use reasonable financial resource allocation to reduce the volatility of the entire economic system. Therefore, the operational management principles of commercial banks are safety, liquidity, and profitability, among which profitability is the most important nature. The improvement of profitability can not only enhance the bank's credit and capital, but also enhance the bank's ability to resist risks and enhance its competitiveness. In 1997, the banking industry in South Korea experienced a foreign exchange crisis. With the merger and expansion of bankrupt banks, the number of banks significantly decreased to improve competitiveness. Although the number of banks in South Korea is gradually decreasing, especially after the post crisis period of the International Monetary Fund, the number of bank branches is gradually increasing（Yoonsok Le，2015）。As of the end of 2018, among OECD countries, only Japan, Greece, and France had bank group stocks with an average PBR lower than South Korea.（Byungho Suh and Heung Jin Kwon，2020)。With the continuous promotion of interest rate marketization, commercial banks are facing huge challenges in their profit model, which mainly relies on interest income. In addition, the downward trend of benchmark interest rates will directly lead to a decrease in depositors of commercial banks, putting certain pressure on their profitability.(Junya Shi,2022.)。Faced with the increasingly competitive financial environment, in order for commercial banks to survive and develop in the long term, they need to improve their profitability and enhance their competitiveness in the financial industry. Therefore, how to continuously improve profitability and enhance their competitiveness in the financial competition environment has become a key issue that Korean commercial banks need to pay attention to. The research on the influencing factors of the profitability of Korean commercial banks is urgent. Analyzing the degree to which the factors affecting the profitability of commercial banks affect their profitability and proposing corresponding countermeasures based on empirical results is of great significance for improving the profitability of Korean commercial banks, ensuring their stable development, and thus having a positive impact on the overall development of Korean commercial banks and the country's economic development.

Based on the research of domestic and foreign literature, and based on the actual situation of listed companies in Korean commercial banks, this article aims to establish econometric models to study the effects of various influencing factors on the profitability of Korean commercial banks. This can encourage operators to consider profitability issues from a more comprehensive perspective, ensure the scientificity of decision-making, eliminate the drawbacks of multi-objective evaluation of bank profitability, better evaluate the value creation ability of listed commercial banks, provide targeted suggestions for listed commercial banks in the implementation of business strategies, and help domestic listed commercial banks find effective ways to improve profitability.

Ⅱ. Literature review

1.A Study on the Factors Influencing the Profitability of Banks

Commercial banks play an important role in the financial life of the national economy, and profitability is crucial for commercial banks. However, many micro, meso, and even macro factors can have different impacts on them (Jiang Yuhui, 2024). With the rise of technology-based financial enterprises, the continuous promotion of interest rate liberalization, the further expansion of the degree of financial market opening up, and the increased pressure of interbank competition, the

profitability of commercial banks is facing great challenges under this new situation (Wang Peidong, 2022). In order to expand financing scale and achieve their own development strategies, urban commercial banks have been listed in recent years. Faced with the continuous advancement of national economic system reform, how to improve the profitability of commercial banks has always been an important part of the financial strategy of urban commercial banks (Gao Fanglu, Yue Xuan, 2020). The factors that affect the profitability of commercial banks mainly include macro and micro aspects. The macro aspects include policies, economy, etc. The micro aspects include financial and non-financial factors. Financial factors include the liquidity level of banks, capital adequacy ratio, asset size, etc. Non-financial factors include business market share, financial innovation ability, etc. Among them, the main influencing factor is financial indicators, which have the most significant impact on profitability.

Kim Min-Jung (2019) found in the empirical results of Korean commercial banks that there is a positive correlation between return on assets (ROA) and total bank branches, capital adequacy ratio of the Bank for International Settlements, GDP (gross domestic product), CPI (consumer price index), and KOSPI (Korea Composite Stock Price Index), as well as a positive correlation between return on equity (ROE) and total loans, and a positive correlation between net interest margin (NIM) and GDP. Jiang Yuhui (2024) explored the factors affecting the profitability of commercial banks based on the relevant data of 13 listed commercial banks from 2016 to 2021. Huang Jinqiu et al. (2006) believed that internal operational efficiency, asset quality, bank size, capital adequacy ratio, liquidity status, and bank size all have an impact on bank profitability. Among them, capital adequacy ratio and bank ROA change in the same direction, while bank asset size and liquidity change in the opposite direction of profitability. Both GDP and inflation rate have a significant positive correlation with bank profitability. Wu Hongtao (2024) conducted an in-depth discussion on the factors affecting the profitability of small and medium-sized banks in the study of the impact of credit business for small and micro enterprises on the profitability of small and medium-sized banks, and found that credit business for small and micro enterprises is one of the important factors affecting the profitability of small and medium-sized banks.

2.A Study on the Selection of Research Methods for Factors Influencing the Profitability of Banks

There are three main research methods for studying the factors affecting bank profitability. The first is to use DEA analysis to evaluate the efficiency of commercial banks and then study the factors affecting their profitability. The second is to establish econometric models using panel data to examine the relationship between bank profitability and various influencing factors over different periods. The third is to construct indicators that affect bank profitability for multivariate analysis.

(1) DEA analysis method

Wang Zhihui (2024) evaluated and analyzed the competitiveness of China's regional listed commercial banks based on entropy method and DEA analysis; Park Seok-Kang (2011) studied the structure and management efficiency of banks in emerging economies based on DEA analysis, using DEA analysis and cluster analysis to analyze the efficiency of major banks in emerging economies (Thailand, Indonesia, Malaysia, and the Philippines), especially analyzing the technical efficiency of banking in emerging economies, and examining the differences in management structure between Korean banks and foreign banks in emerging economies, which had policy implications for the capital market, including financial regulation and bank access regulation in emerging economies. The analysis results showed that although foreign banks have difficulty entering, emerging economies have higher technical efficiency in banking and higher efficiency in the service industry.

(2) Multivariate analysis

Li Hongchao (2023) used the CPV model and multiple linear regression analysis method to analyze the main factors

affecting commercial bank real estate credit risk from a macro level in the measurement and prediction of commercial bank real estate credit risk. He used the model to predict the future non-performing loan ratio of the commercial bank real estate industry. The research results showed that forward-looking indicators (comprehensive leading index, real estate development investment growth rate) and non-material indicators (actual total human capital) have a significant impact on real estate credit risk and exhibit a negative relationship, while the national housing boom index, which reflects the state of the real estate industry, has a positive relationship with real estate credit risk. Zhou Enbo and Jiang Xuemei (2023) selected 38 listed commercial banks from 2009 to 2019 from the perspective of listed commercial banks, and used Stata16.0 software to establish multiple linear regression analysis. In the group regression analysis, it was concluded that the impact of small and medium-sized commercial banks was significant, while the negative correlation between the capital adequacy ratio of large commercial banks and their profitability was not significant. Byungho Suh and Heung Jin Kwon (2020) conducted empirical analysis on the determinants of PBR in OECD countries' banking groups, and conducted regression analysis on the PBR of 391 listed banking groups in OECD countries from 2011 to 2018, identifying the fundamental reason for the undervaluation of Korean banking groups' share prices.

(3) Establishing a measurement model

Qu Xin (2007) conducted a study on the financial data of Chinese commercial banks from 1999 to 2005 to analyze the profitability of Chinese commercial banks. He established a mixed-effects regression model based on the collected panel data to analyze the differences in profitability indicators between state-owned banks and joint-stock banks and the reasons for these differences. Baek Soo-hyun (2021) analyzed the determinants of liquidity risk in 79 savings banks in South Korea and conducted a panel regression analysis using unbalanced panel data. He found that when liquidity risk (measured using financing gap and loan-to-deposit ratio) increases, the structural profitability of savings banks increases; the greater the liquidity risk, the more positive the impact on profitability. Gu Zhengyang (2008) summarized the internal factors affecting Chinese commercial banks into three categories: risk variables, operational variables, and business variables. He used three indicators, namely return on assets, per capita profit, and operating income, as explanatory variables to establish a measurement model and conducted empirical analysis using a mixed-effects model to regress various relevant indicators affecting the profitability of Chinese commercial banks. He compared the differences in empirical results between the two types of banks, analyzed the causes of these differences, and proposed reasonable suggestions based on these causes.

In terms of research methods, fixed-effect and random-effect analysis methods have been widely used in recent years to study the impact of commercial bank profitability, and have been widely recognized. Therefore, based on relevant domestic and foreign literature, this article uses panel data models to construct econometric models to examine the impact of various relevant factors on the profitability of Korean commercial banks, based on mature theoretical systems on bank profitability and its influencing factors.

2. Research content

This article takes Korean commercial banks as the research object, and conducts research on the profitability of commercial banks based on relevant research results at home and abroad. In order to achieve the research objective, this article mainly uses literature research methods, descriptive analysis, and constructing econometric models. This article extensively consults literature on the factors affecting the profitability of commercial banks, as well as the literature on the PBR of the Bank of Korea, to understand the research methods and the construction of indicators for the factors affecting the profitability of Korean commercial banks. It describes and analyzes the current situation and development trend of indicators for the profitability of commercial banks and various influencing variables. Finally, based on the collection of literature, it conducts unit root tests on panel data, and after differentiating unstable sequences, it conducts F-tests and Hausman tests on

variables to select appropriate models for regression analysis, and analyzes the impact of various factors on the profitability of Korean commercial banks.

3. Bank profitability and influencing factors

3.1 Definition of Bank Profitability Concept

The profitability of commercial banks not only refers to the ability of banks to earn profits, but also includes the ability of commercial banks to resist risks, reduce costs, and ensure asset quality. There are six profitability indicators for commercial banks, which generally include return on total assets, return on net assets, basic earnings per share, net profit growth rate, cost-income ratio, and non-performing loan ratio. Return on total assets is the most commonly used proxy indicator for bank profitability in domestic and international research.

The return on total assets is calculated by dividing the total return by the average total assets. It can show the ability of commercial banks to use all assets to generate profits. Therefore, the return on total assets can be used as an important indicator to measure the ability of commercial banks. The higher the return on total assets, the higher the efficiency of capital utilization and the higher the profitability of commercial banks. Therefore, there is a significant positive correlation between the return on total assets and the profitability of commercial banks.

3.2 Factors affecting the profitability of banks

Regarding the factors affecting the profitability of commercial banks, in addition to financial factors, the explanatory power of other factors only accounts for a small portion, and the relationship with the profitability of banks is unstable in different periods. Financial factors are the main influencing factors of commercial banks' profitability and have the strongest explanatory power. Therefore, this study mainly selects financial indicators to study the profitability of banks, mainly considering five aspects.

(1) Asset quality

The asset quality of commercial banks is closely related to their profitability. The most comprehensive performance of the operation of bank assets is profitability. High-quality assets can enable commercial banks to have good profitability, and the improvement of profitability can also improve asset quality. Therefore, it is believed that there is a significant positive correlation between the asset quality of commercial banks and their profitability. The non-performing loan ratio is the ratio of non-performing loans to total loan balances of commercial banks, which is usually used as a sign of the quality of bank assets and directly affects the profitability of commercial banks. Generally, the lower the non-performing loan ratio, the better the asset quality, and the stronger the profitability of commercial banks.

(2) Bank size

The asset size of commercial banks is mainly reflected in economies of scale. Larger banks can reduce average operating costs by increasing operating income. It is generally believed that the larger the scale, the stronger the profitability. Total assets can be used as an indicator to measure the size of a bank. The more total assets a bank has, the larger its scale, and the more disposable capital it has. Having sufficient funds to issue new loans is beneficial for bank profitability.

(3) Bank liquidity

The liquidity of commercial banks refers to their ability to repay in the short term. If a commercial bank has high liquidity, it can more effectively avoid liquidity crises, reduce losses, and benefit the bank's profitability. The loan-to-deposit ratio is one of the important indicators representing the liquidity of banks. It is the total deposits of a bank divided by the

total deposits. The lower the loan-to-deposit ratio, the lower the funds used for loans, the higher the liquidity, and the higher the profitability of commercial banks.

(4) Operational efficiency

The operational efficiency of commercial banks is also an important factor affecting their profitability, and the cost-income ratio is often used as a proxy variable. The cost-income ratio is the ratio of bank operating expenses to operating income. The lower the cost-income ratio, the lower the cost of bank income, the higher the operational efficiency, and the stronger the ability to generate income, which means the stronger the profitability.

(5) Capital adequacy ratio

Capital adequacy ratio is a necessary capital ratio to ensure the normal operation and development of commercial banks, and has a significant positive correlation with profitability. First, when raising funds through external channels, the external financing cost is relatively low. Second, generally speaking, a high capital adequacy ratio can ensure the stable operation of banks and high security, making it easier to attract customer resources and improve profitability. Third, capital has the ability to resist risks and absorb unexpected business losses. Since bank capital can be occupied stably for a long time, it meets the long-term demand for funds and reduces the possibility of bank runs.

Ⅲ. research design

1. Data source

This article selects a total of 12 commercial banks, including Shinhan Bank, Woori Bank, Hanwha Bank, Kookmin Bank, Busan Bank, Hanmi Bank, Hana Bank, and Korea Exchange Bank (KEB Hana Bank), as research samples from 2015 to 2023 based on the principles of data availability and representativeness. The reasons for choosing panel data to establish models in this article are as follows: firstly, panel data models can eliminate the autocorrelation phenomenon that exists in ordinary models; secondly, panel data models can avoid the possible multicollinearity problems that may occur in general models; finally, panel data is more suitable for studying dynamic changes. The research data comes from online databases and annual reports of various banks.

2. Variable selection

This chapter conducts an online survey among different age groups, educational backgrounds, and income levels, which is highly representative. A total of 423 questionnaires were collected in this study, and after excluding invalid questionnaires, a total of 386 valid questionnaires were collected, with a sample recovery rate of 91.3%.

2.1 Selection of profitability indicators

The indicators that can reflect the profitability of banks mainly include return on assets, return on net assets, net profit growth rate, basic earnings per share, cost-income ratio, and non-performing loan ratio.

Among them, return on assets (ROA) and return on equity (ROE) are the most commonly used indicators to measure the profitability of banks. ROE mainly reflects the profitability of bank shareholders, ignoring the profitability of the bank, while ROA mainly reflects the ability of the bank to obtain profits from all resources it operates, making it more suitable as a proxy variable for bank profitability. Therefore, this article chooses return on assets as the indicator to measure profitability.

2.2 Selection of influencing factors

The factors affecting profitability are mainly considered from liquidity, asset quality, capital adequacy ratio, operating efficiency, asset quality, asset size, and other aspects, and variable indicators are selected. The indicators such as loan-to-deposit ratio, non-performing loan ratio, capital adequacy ratio, total assets, and cost-income ratio are used as explanatory variables to explain the factors affecting the return on total assets. The explanatory variables are represented by CAR, CIR, NPL, LDP, LnTA, and other variables. The definitions, symbols, and calculation methods of all variables are shown in Table 1.

Table 1. Profitability of Commercial Banks and Variables Influencing Factors

| Indicator type	Indicator Name	Symbolic representation	Account form
PROFITABILITY	rate of return on total assets	ROD	Total compensation/average total assets
mobility	Loan-to-deposit ratio	LDP	Total loan amount/total deposit amount
Asset adequacy ratio			
	capital adequacy ratio	CAR	Capital/Risk Assets
operating efficiency	Cost to income ratio	CIR	Operating expenses/revenue
Asset quality	Non-performing loan ratio	NPL	Non performing loans/various loans
Asset size	total assets	LnTA	The logarithm of total assets

IV. empirical research

1. Descriptive analysis of bank profitability indicators and influencing factor indicators

1.1 Total asset return rate

As shown in Figure 1, the average return on total assets of commercial banks has some volatility from 2015 to 2023, but overall it shows an upward trend. The specific reasons are as follows:

(1) Improved economic conditions: The upward trend in the return on total assets may reflect the overall improvement in the Korean economy, leading to higher returns for banks.

(2) Improvement of bank operational efficiency: Banks have improved their return on total assets by increasing operational efficiency, reducing costs, and optimizing asset allocation.

(3) Diversification of banking business: Banks have carried out more diversified businesses in different fields, such as investment banking and wealth management, thus improving the return on total assets.

(4) Profit growth: Banks have achieved higher profits during this period, thus improving the return on total assets.

The rising trend of the return on total assets of commercial banks in South Korea may reflect the positive performance of banks in economic and operational aspects, which is a positive signal.
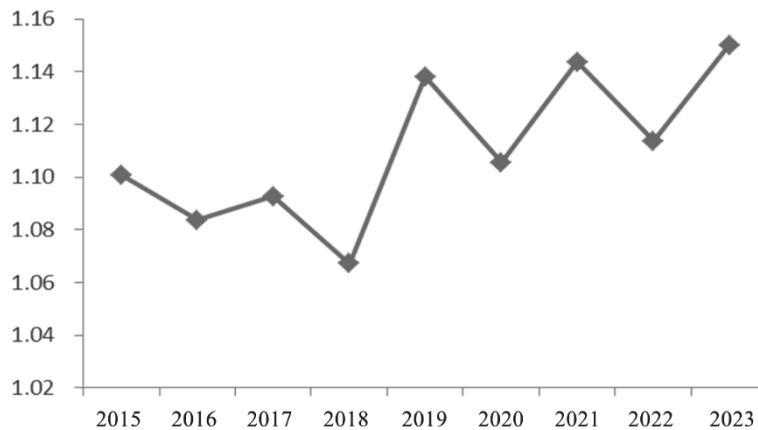
Figure 1. Average return on total assets of commercial banks

1.2 Asset adequacy ratio

As shown in Figure 2, the asset adequacy ratio declined in 2015 and 2020. This decline may be attributed to the significant impact of the 2015 Middle East Respiratory Syndrome (MERS) epidemic on the Korean market, the severe disruption of regional economies caused by the COVID-19 virus epidemic, and the impact on global economic growth. As a result, the Korean economy fell into recession in 2020. The impact of economic crises and overall economic changes has hindered economic development and led to a reduction in capital. However, during these nine years, the average asset adequacy ratio of Korean commercial banks has generally shown an upward trend, with an average level of over 10%.
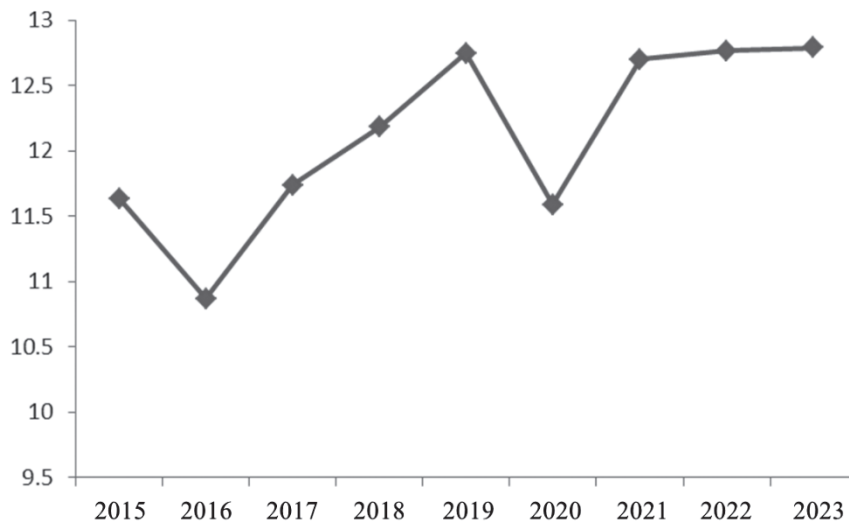

Figure 2. Average asset adequacy ratio of commercial banks

1.3 Total assets

Due to the relatively large value of total assets in commercial banks, taking logarithms does not change the nature and correlation of the data itself, but can reduce the absolute value of the variable. Therefore, logarithmic processing is applied to the data before descriptive analysis.

As shown in Figure 3, the average total assets of commercial banks have been steadily rising since 2015, indicating that banks have increased their own capital and have more funds available for loans. This trend is beneficial for improving the profitability of commercial banks.
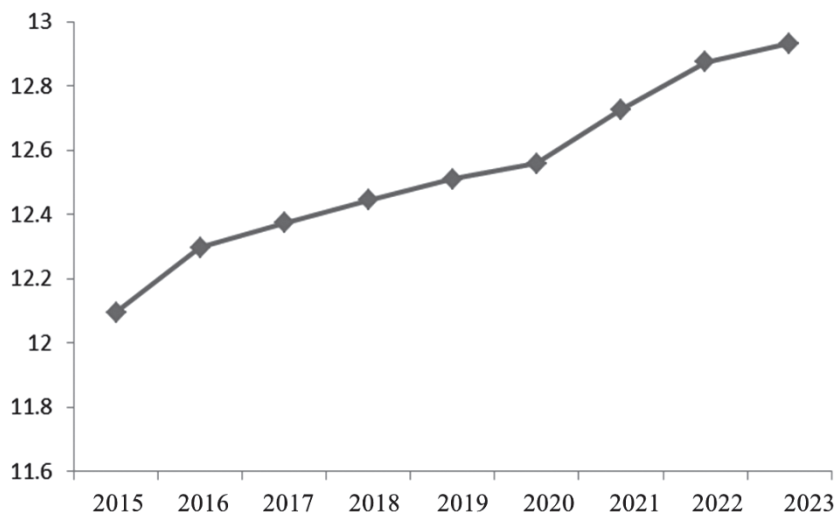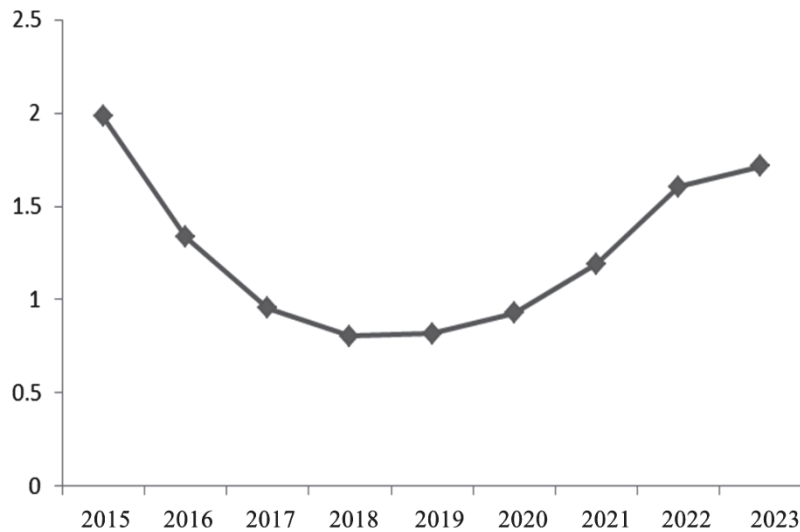

Figure 3: Average total assets of commercial banks

1.4 Non performing loan ratio

As shown in Figure 4, the average non-performing loan ratio of commercial banks in South Korea has experienced two phases of change. From 2015 to 2018, it showed a downward trend, and by 2018, the non-performing loan ratio was as low as below 1%, indicating that commercial banks have controlled the non-performing loan ratio at a relatively low level and maintained a relatively safe and stable operating state in the past few years. However, after 2018, the non-performing loan ratio began to show an upward trend, which may be due to the macro environment and increased competitiveness of the financial industry in South Korea. This trend is not conducive to the improvement of the profitability of South Korean commercial banks.

Figure 4. Average non-performing loan ratio of commercial banks

1.5 Cost to income ratio

As shown in Figure 5, the average cost-income ratio of Korean commercial banks showed an upward trend in 2015, but after 2016, it showed a steady downward trend. This may be due to the emergence of the Middle East Respiratory Syndrome (MERS) epidemic in 2015, which had a phased impact on the cost-income ratio of the macro economy. However, since 2016, Korean commercial banks have begun to adjust their cost management and exercise reasonable control over their cost expenditures, which has kept the cost-income ratio at a relatively stable and low level. This development trend is conducive to the improvement of commercial banks' profitability.
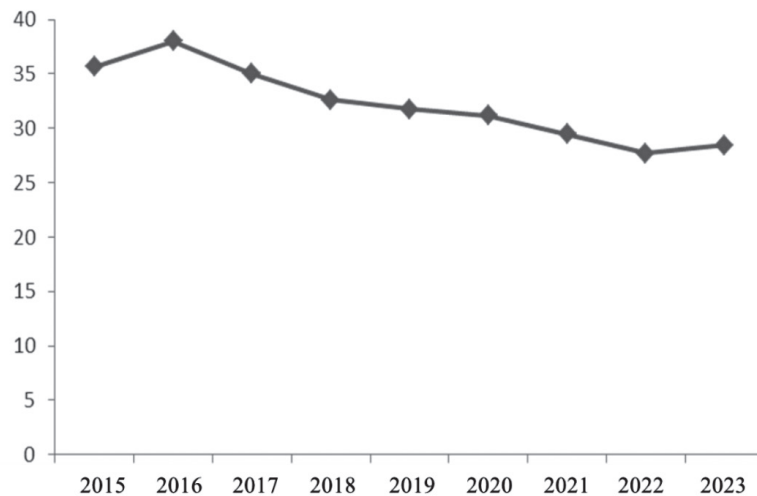
Figure 5. Average cost-income ratio of commercial banks

1.6 Deposit to Loan Ratio

The average loan to deposit ratio of South Korean commercial banks is over 66%. Although there have been fluctuations since 2016, the overall trend is on the rise, which is beneficial for improving the profitability of commercial banks.
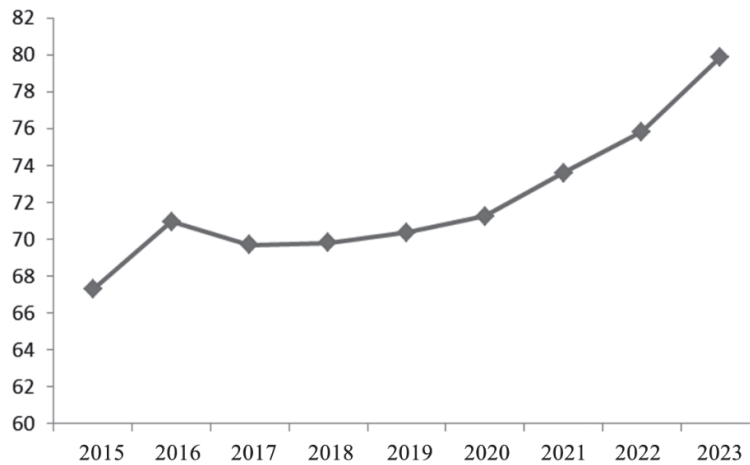
Figure 6. Average Deposit to Loan Ratio of Commercial bank

2. Unit root test

Before conducting regression analysis, it is necessary to conduct a unit root test on the variable data, as some non-stationary variable sequences may exhibit a common trend, resulting in a high degree of goodness of fit in the regression results. However, there may not be a direct correlation between these variables, and if regression analysis is conducted directly, spurious regression may occur. To ensure the accuracy of the regression results, we must conduct a stationarity test on the variable data, and the most commonly used method for stationarity testing is the unit root test.

Null hypothesis: the variable series has a unit root (the variable series is non-stationary)

Alternative hypothesis: The variable series does not have a unit root (the variable series is a stationary series)

Table 2. Unit Root Test Table for Variable Raw Data

Variable	LLC		ADF		IPS	
	T-value	p-value	T-value	P-value	T-value	P-value
ROA	-8.62	0.00	49.37	0.00	43.19	0.00
CAR	-6.59	0.00	52.76	0.00	70.85	0.00
CIR	-9.15	0.00	64.56	0.00	82.05	0.00
NPL	0.53	0.70	19.38	0.62	32.94	0.06
LDP	-3.37	0.00	22.84	0.41	25.21	0.29
LnTA	-9.54	0.00	76.55	0.00	100.07	0.00

From the results in the table above, it can be seen that regardless of the given significance levels of 1%, 5%, or 10%, ROA, CAR, LnTA, and CIR reject the null hypothesis under the three testing methods, indicating that the sequence does not have a unit root and is a stationary sequence. At a significance level of 10%, the p-values of the NPL sequence in the LLC test, ADF test, and IPS test are all greater than 0.1, indicating that the null hypothesis is accepted and that there is a unit root, indicating that the sequence is non-stationary; Under the LLC test, LDP rejects the null hypothesis and is a stationary sequence regardless of significance levels of 1%, 5%, or 10%. However, under the ADF and IPS tests, LDP accepts the null hypothesis and is a non-stationary sequence. Therefore, we consider LDP to be a non-stationary sequence. In summary, ROA, CAR, LnTA, and CIR are stationary sequences, while NPL and LDP are non-stationary sequences. Therefore, we perform first-order differencing on NPL and LDP sequences before conducting unit root tests.

Table 3. Unit Root Test Table for NPL and LDP First Order Difference Order

Variable	LLC		ADF		IPS	
	T-value	p-value	T-value	P-value	T-value	P-value
△ NPL	-8.78	0.00	39.46	0.01	73.19	0.00
△ LDP	-10.02	0.00	58.37	0.00	61.44	0.00

From the above table, it can be seen that at a significance level of 10% or 5%, the p-values of the first-order difference sequences of NPL and LDP are all less than 0.1 under the three test methods, rejecting the null hypothesis. Therefore, there is no unit root for the first-order difference sequences of NPL and LDP, and they are stationary sequences. In summary, ROA, CAR, CIR, and LnTA are 0-order stationary sequences, while NPL and LDP are 1-order stationary sequences. Therefore, perform differential processing on NPL and LDP data. Select ROA as the dependent variable, and CAR, CIR, LnTA, and the first-order difference of NPL and LDP as the explanatory variables for regression analysis.

3. Regression analysis

When establishing panel data models for regression analysis, mixed models or variable intercept models are mainly used, among which variable intercept models are further divided into fixed effects models and random effects models. To select a suitable model, we need to verify the panel data. The main testing methods include F-test and Hausman test. The F-test is used to choose whether to establish a variable intercept model or a mixed model. If the test result is to establish a variable intercept model, then the Hausman test is performed on the panel data to determine whether to choose a fixed effects model or a random effects model for the final panel data model.

3.1 Ftest

Original hypothesis: Establish a mixed effects model.
Alternative hypothesis: Establish a variable intercept model.

$$F = \frac{(SSE_r - SSE_u) / (N - 1)}{SSE_r / (NT - N - 1)}$$

SSEr is the sum of squared residuals of the mixed model, and SSEu is the sum of squared residuals of the fixed effects model. NT represents the number of observations in the panel model, and N represents the number of commercial banks.

Table 4. Statistical Table of Mixed Effects Model

Statistic	Value
R squared	0.31
Residual Sum of Squares	2.99
F test	7.49
P value	0.00
DW	1.09

Table 5. Fixed Effects Model Statistics Table

Statistic	Value
R squared	0.60
Residual Sum of Squares	1.49
F test	6.93
P value	0.00
DW	1.83

From the mixed effects model statistic table 5, it can be seen that the sum of squared residuals (SSEr) of the mixed effects model is 2.99. According to the fixed effects model statistic table, the sum of squared residuals (SSEr) of the fixed effects model is 1.49, N is 11, and NT is 88. The F-value calculated using the formula is 3.81, which is greater than the critical value of the F-test and rejects the original hypothesis. Therefore, a variable intercept model is established.

3.2 Hausman test

The F-test results indicate that the panel data is suitable for the variable intercept model, so it is necessary to perform a Hausman test on the panel data to determine whether to choose a fixed effects model or a random effects model.

Original hypothesis: Establish a random effects regression model.

Alternative hypothesis: Establish a fixed effects regression model.

Table 6 : Hausman test

Random effects test			
Test	Chi square test statistical value	Chi square degree of freedom	P value
Random effects test	1.38	5	0.93

From the Hausman test, it can be seen that the statistical value of the chi square test is 1.38, and the p-value is 0.93, which is greater than 0.05. The null hypothesis is accepted at a significance level of 5%. Therefore, a random effects regression model should be established.

3.3 Establishing a random effects regression model

Table 7. Random Effects Regression Model Table

Variable	Coefficient	T-value	P-value 值
C	1.25	2.14	0.04
NPL	-0.05	-0.88	0.38
CIR	-0.02	-6.51	0.00
LDP	0.01	2.22	0.03
CAR	0.07	2.99	0.00
LnTA	-0.01	-0.30	0.77
R2		0.40	
F statistic		10.91	
P-value		0.00	
DW test		1.07	

From the regression results, it can be seen that the variables LnTA and NPL did not pass the significance test, while the variables CAR, CIR, LDP, and the constant C all passed the significance test, with the degree of significance ranging from strong to weak. Therefore, the final random effect model can be expressed as:

ROA=1.25+0.07*CAR-0.02*CIR +0.01*LDP

T-value (2.14) (3.00 (-6.51) (2.22)

R-squared: 0.40   DW test statistic: 1.07

F value: 10.91   P value corresponding to F value: 0.00

From the final random effect model, the p-value corresponding to the F-test statistic is 0.00, indicating that the model passes the significance test at a significance level of 5% and is valid.

The p-values of the capital adequacy ratio (CAR), operating efficiency (CIR), and liquidity (LDP) variables are 0.00, 0.00, and 0.03, respectively, all of which are less than 0.05, indicating that at a significance level of 5%, the variables of capital adequacy, operating efficiency, and asset size have a significant impact on the profitability of commercial banks. Among them, the capital adequacy ratio has the greatest impact on profitability. The coefficient value of variable CAR at a significance level of 5% is 0.07, indicating that the capital adequacy ratio has a positive impact on the profitability of commercial banks, which is manifested as the stronger the capital adequacy ability of commercial banks, the stronger the profitability. Operating efficiency also has a significant impact on the profitability of commercial banks, with a corresponding coefficient value of -0.02, indicating that there is a significant negative correlation between cost-income ratio and the profitability of commercial banks, that is, the lower the operating costs, the higher the operating income, and the stronger the profitability of commercial banks. This is consistent with common sense. The coefficient value of the loan-to-deposit ratio variable is 0.01, indicating that there is a positive correlation between the loan-to-deposit ratio and bank profitability, that is, the profitability of commercial banks increases with the enhancement of liquidity.

The scale variable LnTA shows a certain inverse relationship with the ROA of banks, but the corresponding p-value is 0.77, indicating that this scale variable did not pass the significance test at the 5% significance level. The scale effect of commercial banks is not obvious, and profitability does not increase with the expansion of scale. This is different from what we generally believe. We generally believe that the larger the bank size, the stronger the profitability of commercial banks.

This result may be due to the fact that if we blindly pursue the expansion of bank size, the coordination and communication costs of banks increase, and risks increase, which leads to a decrease in bank operating efficiency and profitability. The asset quality indicator NPL (non-performing loan ratio) is negatively correlated with ROA, but NPL did not pass the significance test at the 5% significance level, which means that the asset quality of commercial banks has no significant impact on the profitability of commercial banks. This is inconsistent with common sense, and it is likely that South Korea has a strict regulatory system for commercial banks. When banks have serious non-performing loan problems, the regulatory authorities will take measures to pressure commercial banks to control the non-performing loan ratio. Therefore, the lack of correlation between non-performing loan ratio and profitability is likely due to the influence of regulatory authorities controlling the non-performing loan ratio.

Ⅴ. Conclusion and policy implications

1. Reduce differences in consumption habits

This article takes the total asset return rate, which measures the profitability of commercial banks, as the dependent variable, selects asset size, capital adequacy, asset quality, operational efficiency, and liquidity as explanatory variables to construct an empirical model. Using relevant data from Korean commercial banks from 2008 to 2016, an empirical analysis was conducted, and the following conclusions were drawn.

1.1 There is a significant positive correlation between operational efficiency and the profitability of Korean commercial banks

There is a significant negative correlation between the cost-income ratio and the operational efficiency of commercial banks. That is, the lower the cost-income ratio, the lower the operating expenses, and the higher the operating income. The higher the operational efficiency of commercial banks, the higher their profitability will be. Therefore, improving operational efficiency can enhance the profitability of Korean commercial banks. The main way to improve the operational efficiency of commercial banks is to strengthen their cost control. Specific suggestions should be considered from the following aspects:

(1) Adjusting organizational structure

Adjusting the organizational structure and developing the internal structure system of the bank towards scale and specialization, mainly by clarifying the responsibilities and division of labor of team members, improving the execution efficiency of bank employees, and establishing resource sharing mechanisms among various branches and branches to improve operational efficiency.

(2) Strengthen employee management and improve assessment mechanisms

The improvement of the work efficiency of bank employees also plays a crucial role in the operational efficiency of Korean commercial banks. Therefore, we need to enhance the management of bank employees, improve employee training mechanisms, improve their work efficiency and abilities, improve performance evaluation mechanisms, and grasp and assess the specific situation of employees. Employees who are not in an ideal situation can receive secondary training.

(3) Control the scale of commercial banks

In the past period of time, commercial banks have been blindly pursuing the expansion of scale to achieve profitability improvement and achieve the goal of obtaining more profits. Therefore, they have invested a large amount of funds to expand the number of branches. However, excessive expansion of scale has not brought more profits to commercial banks. Instead,

due to poor management of some branches, management expenses have increased and losses have occurred, affecting the overall profitability of the banking industry. Therefore, South Korean commercial banks need to control the scale of branch expansion, appropriately close branches with unfavorable business conditions, control the scale of commercial banks, and adjust the structure of specific businesses. For some tasks with heavy workload, such as risk management and internal audit, they should be adjusted to the head office or first level branches. Branch offices are mainly responsible for basic businesses such as deposits and loans, and work together at all levels to improve efficiency.

2. Capital adequacy ratio has a positive impact on the profitability of Korean commercial banks

This article uses capital adequacy ratio as a variable to measure capital adequacy capability. The regression results show a positive correlation between capital adequacy ratio and the profitability of banks, indicating that improving capital adequacy capability is beneficial for enhancing the profitability of commercial banks.

There are two main ways to improve capital adequacy ratio: increasing capital and reducing risk weighted assets. Therefore, commercial banks can take the following measures:

(1) Expand channels to raise capital

Supplementing bank capital through multiple channels, for commercial banks that have not yet been listed, they can absorb funds through shareholding reform and public listing through multiple channels; Change the equity structure to promote diversification. Increase the total capital to improve its capital adequacy ratio. At the same time, commercial banks should flexibly apply methods such as increasing new shares, rights issues, subordinated bonds, convertible bonds, and mixed capital instruments to expand their total capital and improve their capital adequacy ratio.

(2) Effectively managing non-performing loans

Commercial banks can increase their capital adequacy ratio in order to effectively control and handle non-performing loans, which requires the reuse of non-performing loans. The main measures include asset transfer, restructuring, asset securitization, etc., and the reuse of non-performing loans to increase capital adequacy ratio.

(3) Establish a more comprehensive risk management system

Commercial banks should improve their risk management system by constructing models or using advanced measurement methods to more accurately estimate and control the risks (including market and operational risks) that commercial banks face, achieving effective risk avoidance and reducing their capital use in risk management.

3. Liquidity has a positive impact on the profitability of Korean commercial banks

This article uses the loan to deposit ratio as an indicator to measure the liquidity of bank resources. The regression results show a negative correlation between the loan to deposit ratio and the profitability of banks. The stronger the loan to deposit ratio, the weaker the liquidity of commercial bank resources, leading to a decrease in the profitability of commercial banks. Therefore, improving the liquidity of bank resources can enhance the profitability of banks.

3.1 Establish a dedicated risk management organizational system

Establish a professional risk management department to control the liquidity of commercial banks. Hire experienced risk management personnel to conduct in-depth research on the liquidity of commercial banks, real-time grasp of internal fund raising and utilization, as well as liquidity demand and supply situation. Based on the specific liquidity situation of

commercial banks, make timely adjustments to prevent insufficient and excessive positions.

3.2 Expanding financing channels for commercial banks

To maintain good liquidity, commercial banks need to maintain a certain dynamic balance between assets and liabilities. When facing customer withdrawals of cash, commercial banks can monetize their short-term bonds to obtain liquid assets, or borrow funds from the capital market at a reasonable interest rate to solve customer withdrawal pressure and ensure the liquidity of commercial banks. If commercial banks have a large amount of liquid assets, they can invest the excess funds to gain profits. The government should also try its best to create conditions for commercial banks to maintain good liquidity. On the one hand, the government should develop marketization of securities investment, expand financing channels for commercial banks, and create market conditions to ensure liquidity. For example, it can increase varieties in the treasury bond market.

On the other hand, it is necessary to improve the management mechanisms of interbank lending and the bill market. For example, banks with mature management mechanisms can issue financial bonds in the capital market to improve their liquidity.

3.3 The impact of asset quality and scale on the profitability of banks needs to be investigated

In this study, total assets and non-performing loan ratio were used as variables to measure size and asset quality. In the regression analysis of this article, the variables did not pass the significance test, but this does not indicate that the asset quality and size of banks have no relationship with the profitability of commercial banks. The reason may be related to the inappropriate selection of indicators for the size and asset quality of commercial banks, which requires further investigation and research.

References

Jiang Yuhui. Research and Analysis on the Factors Affecting the Profitability of Commercial Banks [J]. Market Weekly, 2024, 37(03): 41-46

Wang Peidong. Empirical Study on the Factors Affecting the Profitability of Commercial Banks [D]. Supervisor: Li Dongxia. Henan University of Finance and Economics, 2022

Gao Fanglu, Yue Xuan. Analysis of the factors affecting the profitability of China's urban commercial banks [A]. Tianjin Federation of Social Sciences. Outstanding Papers of the 16th Annual Academic Conference of Tianjin Federation of Social Sciences. Remarkable Advantages of the Socialist System with Chinese Characteristics and the National Governance System (in Chinese) [C]. Tianjin Publishing Media Group, Tianjin People's Publishing House: Tianjin Federation of Social Sciences, 2020: 11

Huang Jinqiu, Qu Xin, Zhang Qiaoyun. Main factors affecting the profitability of Chinese commercial banks [J]. Statistics and Decision Making, 2006 (5): 118-119

Qu Xin. Empirical Study on the Factors Affecting the Profitability of Chinese Commercial Banks [J]. Southwestern University of Finance and Economics, 2007

Gu Zhengyang. Empirical Study on Factors Affecting the Profitability of Commercial Banks [J]. Zhejiang University China Excellent Master's and Doctoral Dissertations Database, 2008

Shi Junya. Research on the Profitability of Bank of Zhengzhou and Its Influencing Factors [D]. Supervisor: Pang Ming. Xi'an Shiyou University, 2022

Zhou Enbo and Jiang Xuemei. Empirical Analysis of the Impact of Capital Adequacy Ratio on the Profitability of Listed Commercial Banks in China [J]. Operation and Management, 2023, (02): 57-62

Li Hongchao. Measurement and Prediction of Real Estate Credit Risk in Commercial Banks: Based on Multiple Linear Regression Analysis Method [J]. Shanghai Real Estate, 2023, (11): 40-45

Wu Hongtao. Research on the Impact of Small and Micro Enterprise Credit Business on the Profitability of Small and Medium-sized Banks [D]. Supervisor: Liu Changgeng; Yang Chunbai. Xiangtan University, 2024

Wang Zhihui. Evaluation and Analysis of the Competitiveness of China's Regional Listed Commercial Banks Based on Entropy Method and DEA [D]. Supervisor: Chen Long; Wang Qingdong. Hebei University of Geosciences, 2024

"Analysis of Determinants of Business Performance in Domestic Commercial Banks", Ph.D. Thesis from Qingnan University in China, 2019. Qingshang South Road

Yoonsok Lee. "Analysis of Changes and Factors Influencing the Number of Domestic Bank Branches" KIF Financial Analysis Report 2015.1 (2015): 1-116.

Byungho Suh and Heung Jin Kwon. "Analysis and Inspiration on the Determinants of PBR in OECD Member State Banking Groups" KIF Research Report 2020.5 (2020): 1-124.

Pu Xijiang. "Research on the Structure and Operating Efficiency of Emerging Economic Circle Banks Based on DEA Analysis" Industrial Economic Research 24.2 (2011): 1123-146.

Pei Xiuxian. "Analysis of Determinants of Liquidity Risk in Savings Banks" Business Education Research 35.1 (2021): 95-112.