ANALYZING AND EVALUATING HOW HOUSEHOLD LOAN DELINQUENCY AFFECTS BANK PROFITABILITY IN KOREA'S MAJOR COMMERCIAL BANKS BEFORE AND AFTER COVID-19 (2015–2024)

THESIS

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This thesis is a presentation of our original research work. Wherever contribution of others is involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgment of collaborative research and discussions.

Also, this work is being submitted in partial fulfilment of the requirements for the Master of Business Administration degree and has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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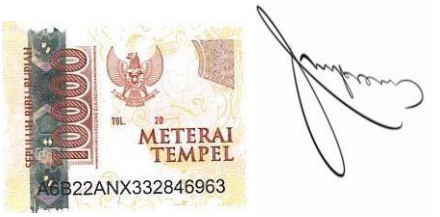

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ABSTRACT

This study examines whether household loan delinquency affects the profitability of Korea's four major commercial banks before and after COVID-19, using year-end data from 2015 to 2024. The sample comprises KB Kookmin Bank, Shinhan Bank, Hana Bank, and Woori Bank, and profitability is measured by return on assets (ROA) and return on equity (ROE). The key explanatory variable is the household loan delinquency rate, while capital adequacy (CAR), non-performing loans (NPL), operating efficiency (CIR), and liquidity (LDR) are included as CAMELS-based control variables. The empirical results show that bank profitability differs between the pre-COVID and COVID-19 periods for ROE but not for ROA, so the hypothesis of a profitability difference is only partially supported. Household loan delinquency does not have a statistically significant effect on either ROA or ROE. Instead, NPL and CIR emerge as the main determinants of bank profitability, whereas CAR and LDR play only a minor role. The COVID-19 indicator is negative and significant, suggesting that the pandemic reduced profitability, while its interaction with household loan delinquency is insignificant, implying that COVID-19 did not materially change the effect of household loan delinquency. Overall, the findings indicate that, for Korean commercial banks, asset quality and cost efficiency are more important drivers of profitability than household loan delinquency.

Keywords : Household loan delinquency, COVID-19, Return on Assets (ROA), Return on Equity (ROE)

CHAPTER 1

INTRODUCTION

1.1 Industry Background

1.1.1 Overview of the Banking Industry in South Korea

The banking industry in South Korea is a central part of the national economy and has an oligopolistic structure, meaning that a small number of large banks dominate most of the market. According to the Financial Supervisory Service (FSS), as of December 2024, South Korea had a total of 18 domestic banks, consisting of four nationwide commercial banks, six regional banks, three internet-only banks, and five specialized banks, along with 35 foreign bank branches.

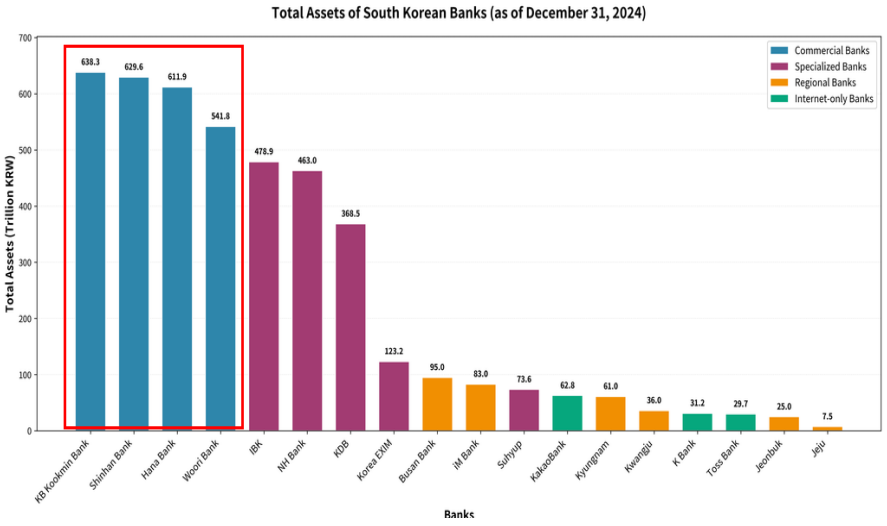

Figure 1-1. Total Assets of Banks in South Korea

Source: Financial Supervisory Service (FSS)

.The four nationwide commercial banks—KB Kookmin, Shinhan, Hana, and Woori—are by far the largest and most dominant institutions in Korea's banking system. As of December 2024, KB Kookmin Bank held total assets of 638.3 trillion KRW, Shinhan Bank 629.6 trillion KRW, Hana Bank 611.9 trillion KRW, and Woori Bank 541.8 trillion KRW. Together, these four banks held 2,421.6 trillion KRW in total assets, representing a decisive share of Korea's commercial banking sector. Because these banks control most of the lending market for both households and businesses, changes in their profitability and credit risk are closely linked to the overall health and stability of Korea's financial system.

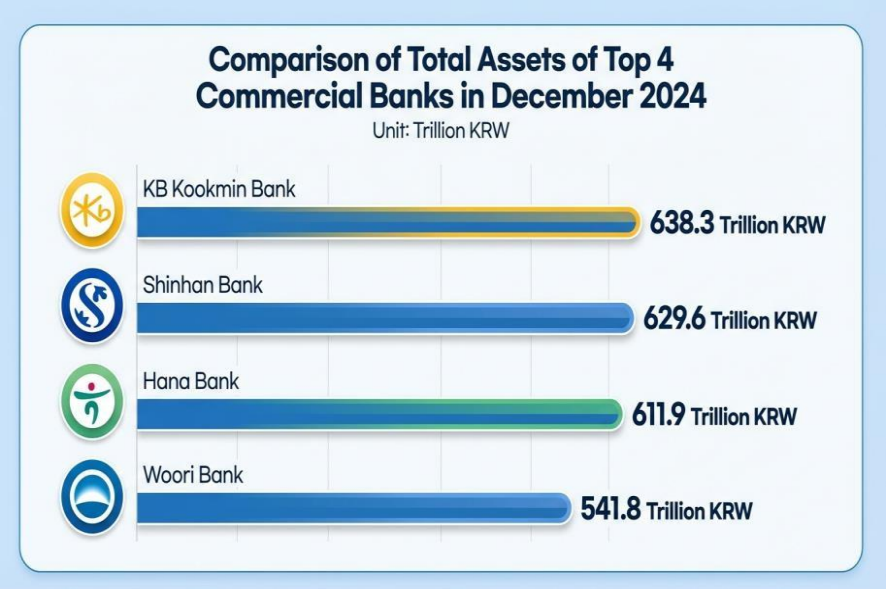

Figure 1-2. Commercial Banks in South Korea
Source: Financial Supervisory Service (FSS)

Historically, Korean banks have relied heavily on interest income—the profit earned from the difference between interest paid to depositors and interest charged to borrowers. This business model makes bank profits very sensitive to macroeconomic conditions and changes in interest rate policy, especially when household debt levels

are high. During the 2010s, a long period of low interest rates encouraged strong growth in household borrowing and supported relatively stable bank earnings.

However, the operating environment changed significantly during and after the COVID-19 pandemic. The Bank of Korea's monetary policy shifted dramatically from historic lows (0.5% in 2020) to sharp increases (3.5% by early 2023) in response to inflation. These interest rate changes, combined with the withdrawal of government support programs, have raised serious concerns about household loan delinquency and credit risk, which are examined in detail in Section 1.1.3.

1.1.2 Household Loan Growth and Credit Risk

Household debt has been a persistent challenge for the South Korean economy. According to data from the Bank for International Settlements (BIS) and the Bank of Korea (BOK), Korea's household debt-to-GDP ratio reached 101.9% in late 2021, one of the highest levels globally. Although the ratio has declined slightly in recent years, it remained elevated at 89.7% as of mid-2024, indicating that Korean households carry a very heavy debt burden relative to the size of the economy.

The growth in household loans has been driven primarily by mortgages and housing-related loans, particularly in major urban areas such as Seoul. Many borrowers, especially younger generations, took out large loans to purchase residential property during periods of rapid house price appreciation. A significant source of risk is that many of these loans carry floating interest rates,

meaning the interest rate adjusts periodically based on market conditions.

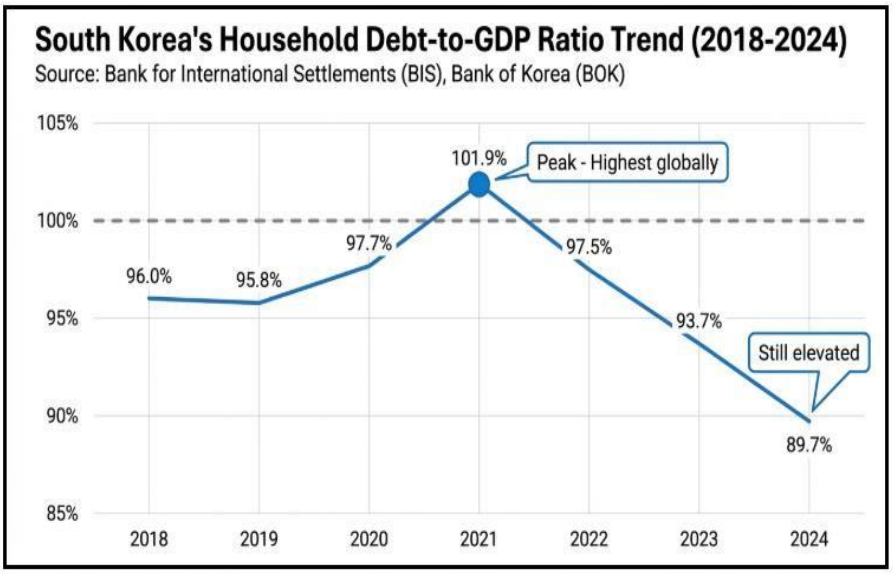

Figure 1-3. South Korea's Household Debt-to-GDP Ratio Trend
Source: Bank for International Settlements (BIS)

While payments remained manageable during the extended period of low interest rates in the 2010s and early 2020s, the sharp increases in the Bank of Korea's base rate beginning in late 2022 led to a substantial rise in debt servicing costs for borrowers with floating-rate loans. This has put many households, particularly those with high leverage or limited income growth, at heightened risk of loan delinquency, which in turn creates significant challenges for banks.

When the delinquency rate rises, banks must increase their loan loss provisions—funds set aside to cover potential losses from non-performing loans—which directly reduces net income and thus lowers return on assets (ROA) and return on equity (ROE). This risk is particularly acute for vulnerable borrower groups, such as those

with lower credit scores, multiple outstanding loans, or limited financial flexibility.

1.1.3 Impact of COVID-19 on the Korean Banking Sector

The COVID-19 pandemic affected the Korean banking sector in two very different phases, with major implications for bank health and credit risk.

- Phase 1: The Pandemic Period (2020–2021)

During the pandemic, the government and the Bank of Korea provided strong support to help the economy and households survive. The Bank of Korea cut interest rates to a historic low of 0.5%, and the government allowed borrowers to delay their loan payments temporarily. These measures made it easier for people to pay their debts. As a result, delinquency rates fell to record lows.

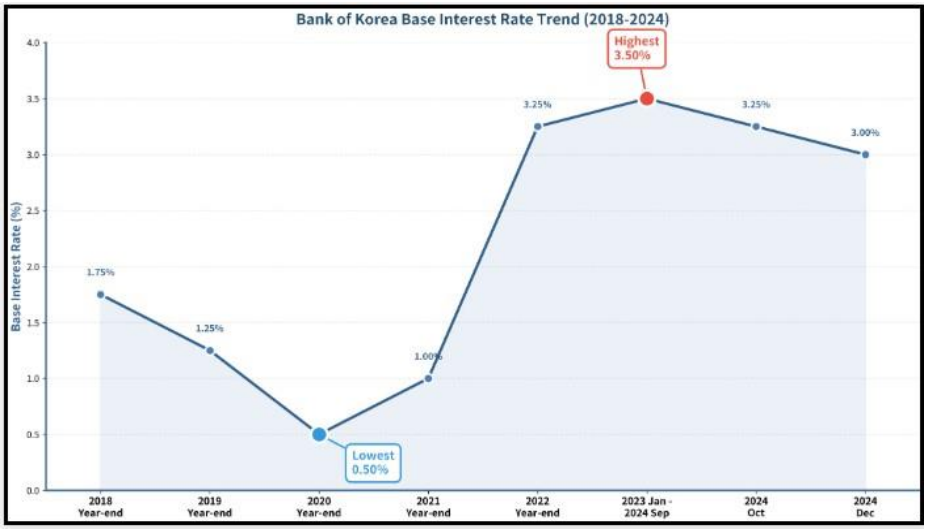

Figure 1-4. Bank of Korea Base Interest Rate Changes

Source: Bank of Korea (BOK)

- Phase 2: The Post-Pandemic Period (2022–2024)

Starting in late 2022, the situation changed completely. To fight inflation, the Bank of Korea raised interest rates from 0.5% to 3.5%. Government support programs ended in September 2023. Borrowers now face much higher monthly payments without the help they had during the pandemic. Because of this, delinquency rates began to rise in 2023 and beyond. This shift—from very low delinquency during the pandemic to rising delinquency after support ended—is a major challenge for bank profits and financial stability today.\

1.2 Research Problem

During COVID-19, government support programs kept household loan delinquency rates artificially low. Once these measures ended and interest rates rose, repayment pressure increased and delinquencies became a growing concern for banks' profitability. However, there is still limited empirical evidence on how the household loan delinquency rate affects bank profitability under these conditions, especially for large Korean commercial banks.

To isolate the effect of household loan delinquency from other profitability drivers, this study employs CAMELS-framework control variables that capture capital adequacy, asset quality, earnings, liquidity, and related risk factors. Against this background, the central research problem of this study is whether the effect of household loan delinquency on bank profitability differs between the period before COVID-19 and the period after COVID-19.

Accordingly, this study addresses the following question: Does the household loan delinquency rate affect the profitability of

Korea’s commercial banks differently before and after COVID-19, when controlling for other factors?

1.3 Research Questions

The research questions framing this study are as follows:

1. How does bank profitability differ before and after COVID-19 (2015–2019 vs. 2020–2024)?
2. How do household loan delinquency rates affect bank profitability?
3. Does COVID-19 moderate the effect of household loan delinquency rates on bank profitability?

1.4 Research Objectives

The main objective of this study is to analyze and evaluate how COVID-19 affects the relationship between household loan delinquency rates and the profitability of Korean commercial banks between 2015 and 2024. The specific objectives are as follows:

1. To examine differences in bank profitability, measured by Return on Assets (ROA) and Return on Equity (ROE), before and after COVID-19 (2015–2019 vs. 2020–2024).
2. To examine the effect of household loan delinquency rates on bank profitability.
3. To examine whether COVID-19 moderates the effect of household loan delinquency rates on bank profitability.

1.5 Significance of the Study

This study has significance in terms of both its novelty and its research benefits.

1. Novelty

First, this study examines COVID-19's two-phase structure for Korean banks: an initial phase where policy support suppressed reported household loan delinquencies (2020–2021), followed by a phase where the withdrawal of support and higher interest rates exposed underlying vulnerabilities (2022–2024), which prior research largely overlooks.

Second, it treats Korea as a critical test case. Korea's household debt is among the highest in the world (around 100% of GDP), and a large share of mortgages are floating-rate, making households highly sensitive to interest rate increases.

2. Research Benefits

Theoretically, the study deepens understanding of how household loan delinquency rates affect the profitability of Korean commercial banks before and after COVID-19 and provides a reference for future research on banking and household finance in highly leveraged economies.

Practically, the findings offer evidence-based insights for Korean commercial banks in managing household loan risk and designing provisioning, pricing, and stress-testing policies, and they help policymakers and investors assess banking sector soundness by focusing on delinquency and debt-servicing capacity as well as overall debt levels.

1.6 Scope and Limitations of the Study

This section outlines the boundaries of the study and the main constraints on the interpretation of the findings.

Scope

1. Target banks: The study focuses on the four major commercial banks in South Korea—KB Kookmin Bank, Shinhan Bank, Hana Bank, and Woori Bank—which together account for a substantial share of the national banking market.
2. Period: The analysis covers the period from 2015 to 2024, allowing for a comparison of bank performance before and after the COVID-19 pandemic.
3. Data: The study uses annual year-end, consolidated financial statement data, yielding 40 bank-year observations (4 banks × 10 years).
4. Variables: The empirical model centers on household loan delinquency rates as the main explanatory variable, with selected CAMEL-based indicators (excluding Sensitivity to market risk) included as control variables to isolate the effect on bank profitability.

Limitations

1. Data: The analysis relies on publicly available, aggregated financial statement data and does not incorporate borrower-level information or detailed loan contract characteristics, which may limit the granularity of risk assessment.

2. Bank coverage: Only the four largest commercial banks are included. Regional banks, mutual savings banks, specialized

banks, and internet-only banks are excluded, so the findings may not be fully generalizable to the entire Korean banking sector.

3. Risk and profitability drivers: The study focuses on credit risk related to household loan delinquency and a selected set of CAMEL-based control variables, while other potential determinants of profitability—such as detailed non-interest income composition, market-risk-related Sensitivity (the "S" in CAMELS), and bank-specific strategic choices—are not examined in depth.

4. COVID-19 framing: The classification of "before" and "after" COVID-19 is based on calendar years (2015–2019 vs. 2020–2024) and does not capture intra-year shocks or policy interventions at a higher frequency.

1.7 Description of Research Method

This study adopts a quantitative research design using annual year-end data for four major Korean commercial banks (KB Kookmin, Shinhan, Hana, and Woori) over the period 2015–2024. Descriptive statistics are first used to summarize the variables, followed by normality tests to assess the distribution of bank profitability measures. Depending on the normality results, paired-sample t-tests are then employed to compare bank profitability before and after COVID-19 (2015–2019 vs. 2020–2024). Bank profitability is measured using Return on Assets (ROA) and Return on Equity (ROE), and regression analysis is conducted to examine how household loan delinquency rates affect these profitability indicators while controlling for CAMEL-based variables capturing capital adequacy, asset quality, management

efficiency, and liquidity, with a COVID-19 dummy included as a moderating variable. The data sources, variable definitions, and model specification are described in detail in Chapter 3.

1.8 Research Structure

This thesis is organized into five chapters. Chapter 1 introduces the research background, problem statement, objectives, research questions, significance, scope, and research method. Chapter 2 reviews the relevant theoretical foundations and previous empirical research on bank profitability, credit risk, and household loan delinquency, and develops the research hypotheses. Chapter 3 describes the research design, data, variables, and statistical procedures employed in the analysis. Chapter 4 presents and interprets the empirical results. Chapter 5 concludes the study by summarizing the main findings, discussing their implications, acknowledging the limitations, and proposing directions for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Bank Profitability and Financial Performance

Bank profitability reflects how efficiently banks turn assets and equity into earnings. ROA measures net income relative to total assets and captures asset-use efficiency, while ROE measures net income relative to shareholders' equity and reflects the return to equity investors and the effect of leverage (Athanasoglou et al., 2008; Dietrich & Wanzenried, 2011). Prior research shows that profitability depends on internal factors such as asset quality, capital adequacy, and cost efficiency, as well as macroeconomic conditions, and that higher NPLs reduce ROA and ROE by increasing provisions and limiting lending (Menicucci & Paolucci, 2016). In line with this evidence, this study expects that weaker asset quality, reflected in higher household loan delinquency, will be associated with lower bank profitability.

2.2 Household Loans and Credit Risk

Household loans are a major asset class and income source for Korean commercial banks but also a key source of credit risk (Choudhry, 2011). In a system with high mortgage concentration and widespread floating-rate and bullet-repayment loans, increases in interest rates or falls in housing prices can quickly weaken household repayment capacity and raise delinquencies (Kim & Han, 2018). Higher household delinquencies then accumulate as bad debts and

threaten banks' financial soundness. These features suggest that in Korea's household-loan-driven banking system, increases in household loan delinquency are likely to translate into higher credit risk and weaker bank profitability.

2.3 Delinquency Rates and Bank Stability

Loan delinquency rates are leading indicators of asset-quality problems and are closely linked to bank stability (Segura & Suarez, 2017). Rising delinquencies delay cash inflows and increase liquidity risk, and they require higher loan loss provisions, which reduce current earnings and erode capital buffers (Vodová, 2013). As banks respond by tightening credit, real activity can weaken further and default risk can increase, reinforcing pressure on profitability (Louzis et al., 2012). This literature indicates that delinquency rates are not only early warning indicators of asset-quality deterioration but also important drivers of bank profitability and stability, underscoring the need to examine their impact on ROA and ROE.

2.4 COVID-19 and the Banking Sector

COVID-19 raised bank credit risk and pressured loan portfolio quality, while also triggering large-scale policy support (Goodell, 2020). Studies find that higher credit risk, measured by NPLs or delinquencies, lowers bank profitability through higher provisions and weaker net interest income (Hardianti & Aziz, 2021; Rahmi & Sumirat, 2021). Payment holidays, restructuring, and very low interest rates kept reported delinquencies unusually low, and later rate hikes and the withdrawal of support led to a "normalization" of delinquencies from these artificially suppressed levels (Bertsch et

al., 2021; MetLife Investments, 2025). This suggests that COVID-19 and related policies may have affected not only the level of household loan delinquency, but also the observed relationship between delinquency and bank profitability over time (Ozdemir et al., 2024; Poposka et al., 2024). Accordingly, this study treats COVID-19 as a potential moderating factor in the link between household loan delinquency and bank profitability.

2.5 Banking risk, Information, and CAMELS

1. Risk–Return Trade-off Theory

Under the risk–return trade-off, higher credit risk is expected to be compensated by higher expected returns, but only up to the point where losses remain manageable. External shocks that trigger a rise in delinquency increase non-performing loans and force banks to raise loan loss provisions, which in turn reduce net interest income and overall profitability. In this view, deteriorating asset quality diverts capital away from income-generating activities toward loss absorption and reserves, thereby weakening bank performance (Berger & DeYoung, 1997). This perspective motivates testing whether higher household loan delinquency, as an indicator of credit risk, is associated with lower bank profitability in Korean commercial banks.

2. Asymmetric Information Theory

Asymmetric information theory provides an additional channel through which credit risk can erode bank profitability. In crisis periods, banks cannot perfectly distinguish between solvent and insolvent borrowers, so higher lending rates or tighter conditions

may worsen adverse selection: relatively high-risk borrowers are more likely to seek credit, while safer borrowers withdraw. This shift in the borrower pool, combined with moral hazard after the loan is granted, leads to a concentration of risky loans in banks' portfolios and ultimately degrades profitability (Stiglitz & Weiss, 1981). This framework supports the expectation that increases in household credit risk, especially under heightened uncertainty such as COVID-19, can weaken bank profitability.

3. CAMELS Framework Theory

The CAMELS framework is a supervisory rating system that evaluates banks across six dimensions: capital adequacy, asset quality, management efficiency, earnings, liquidity, and sensitivity to market risk. A CAMELS rating thus provides a concise definition of a bank's overall soundness, and using CAMELS-based indicators as control variables helps this study isolate the effect of household loan delinquency on profitability from other aspects of banks' financial health and risk management (Dang, 2021; Dash & Das, 2009; Aspal & Dhawan, 2016; Sarker, 2005).

In this study, measures of capital adequacy, asset quality, management efficiency, and liquidity are included as control variables, while sensitivity to market risk is not modeled explicitly so that the analysis can focus on credit-risk-driven effects on profitability. Together, these theoretical perspectives provide the foundation for the hypotheses on how household loan delinquency affects bank profitability and how COVID-19 may moderate this relationship.

2.6 Previous Research

1. Credit Risk and Bank Profitability

Previous studies show that higher non-performing loan (NPL) ratios are associated with lower bank profitability (ROA and ROE). Rising NPLs force banks to increase loan loss provisions and reduce net interest income, weakening profitability (Güngör, 2007; Khemraj & Pasha, 2017; Alsakka & ap Gwilym, 2019; Akinlo et al., 2020).

2. Household Credit Risk in Korean Banking

Korean evidence supports these findings. Seo (2023) shows that Korean banks' financial characteristics—capital adequacy, asset quality, and profitability—significantly affect household loan portfolios. Better-capitalized banks extend riskier variable-rate household loans with higher default probability, implying a tighter linkage between household credit risk and future profitability in Korean banking (Seo, 2023).

3. Financial Performance and Bank Valuation: Indonesia vs. Korea

Kowoon, Sembel, and Malau (2022) compared the top five banks in Indonesia and Korea, examining how financial indicators affect the price-earnings ratio (PER) with interest rate as a moderating variable. ROE and NIM significantly affect PER in both countries, while LDR, total assets turnover, and assets to equity do not. Interest rates show a marginal moderating effect in Indonesia but none in Korea, suggesting that the influence of external factors on bank valuation differs by country (Kowoon et al., 2022).

2.7 Definition of Variables

The variables employed in this study are defined based on established banking literature and financial theory.

2.7.1 Household Loan Delinquency Rate

The household loan delinquency rate measures the proportion of household loans that are overdue by one month or more, expressed as a percentage of total household loans. While non-performing loans (NPLs) typically refer to loans overdue for three months or longer, the delinquency rate is a more sensitive early indicator of asset quality problems (Louzis et al., 2012). Rising delinquency rates signal that borrowers are having difficulty making loan payments, which directly threatens bank financial stability.

2.7.2 Return on Assets (ROA)

Return on Assets is calculated as net income divided by total assets. ROA measures how efficiently bank management converts assets into profits (Athanasoglou et al., 2008). In this study, ROA captures the overall impact of credit losses and loan provisioning on bank operating performance.

2.7.3 Return on Equity (ROE)

Return on Equity is calculated as net income divided by shareholders' equity. Unlike ROA, which reflects overall asset efficiency, ROE incorporates the effects of financial leverage and directly measures returns to shareholders (Dietrich & Wanzenried, 2011). ROE is particularly useful for analyzing how credit

deterioration affects shareholder returns, especially during periods of economic stress.

2.7.4 COVID-19 Period

The COVID-19 pandemic represents a structural economic break that altered financial system dynamics. (Holston et al., 2023) demonstrate that the pandemic changed monetary policy transmission mechanisms, with distinct shock structures during the crisis period compared to normal times. This structural shift enables examination of whether pandemic-related policy support and subsequent monetary policy normalization changed the relationship between household loan delinquency rates and bank profitability across distinct economic regimes.

2.7.5 Control variables

The CAMELS framework summarizes a set of bank-specific indicators capturing Capital Adequacy, Asset Quality, Management Efficiency, and Liquidity. In the original supervisory context, this framework is often referred to as CAMELS, where the additional S represents Sensitivity to market risk. In this study, the Sensitivity component is excluded because the focus is on credit-risk-related household loan delinquency rather than market risk. For the same reason, the Earnings component is also omitted, as bank earnings are typically proxied by ROA or ROE, which already serve as the dependent variables in this model; including a separate earnings proxy would be redundant.

2.8 Hypothesis Development

Based on the theories and empirical studies reviewed in Chapter 2, this study develops hypotheses on (i) differences in bank

profitability before and after COVID-19, (ii) the effect of household loan delinquency rates on bank profitability, and (iii) the moderating role of COVID-19, while controlling for CAMELS-based bank characteristics.

2.8.1 Difference in Bank Profitability (Pre- vs. Post-COVID-19)

Goodell (2020) shows that the COVID-19 pandemic and related policy measures altered banks' risk profiles and earnings compared with the pre-crisis period. Similarly, Bertsch et al. (2021) find that support measures and their later withdrawal affected reported loan quality and profitability. Therefore, the following hypothesis can be developed:

H1: There is a difference in bank profitability (ROA, ROE) before and after COVID-19 (2015–2019 vs. 2020–2024).

2.8.2 Effect of Household Loan Delinquency on Profitability

Athanasoglou et al. (2008) report that weaker asset quality and higher non-performing loans reduce bank profitability by increasing provisions and limiting lending. Menicucci and Paolucci (2016) also find that asset quality and credit risk are key determinants of ROA and ROE. In the Korean context, Kim and Han (2018) highlight the importance of household credit risk for banks' financial soundness. Based on this evidence, higher household loan delinquency is expected to weaken bank profitability. Therefore, the following hypotheses can be developed:

H2: Household loan delinquency rates have a negative effect on bank profitability.

H2-a: Household loan delinquency rates have a negative effect on Return on Assets (ROA).

H2-b: Household loan delinquency rates have a negative effect on Return on Equity (ROE).

2.8.3 Moderating Role of COVID-19

Bertsch et al. (2021) show that payment holidays and other support measures during COVID-19 temporarily suppressed reported delinquencies, and that delinquencies later normalized as support was withdrawn. MetLife Investments (2025) similarly notes that rising interest rates after the pandemic led to an increase in delinquency from artificially low levels. These findings suggest that COVID-19 can change how delinquency translates into bank profitability. Therefore, the following hypotheses can be developed:

H3: COVID-19 moderates the effect of household loan delinquency rates on bank profitability.

H3-a: COVID-19 moderates the effect of household loan delinquency rates on Return on Assets (ROA).

H3-b: COVID-19 moderates the effect of household loan delinquency rates on Return on Equity (ROE).

2.9 Research Framework

"The research framework integrates variables and hypotheses to examine how COVID-19 alters credit risk transmission from household loan delinquency to bank profitability across distinct economic regimes.

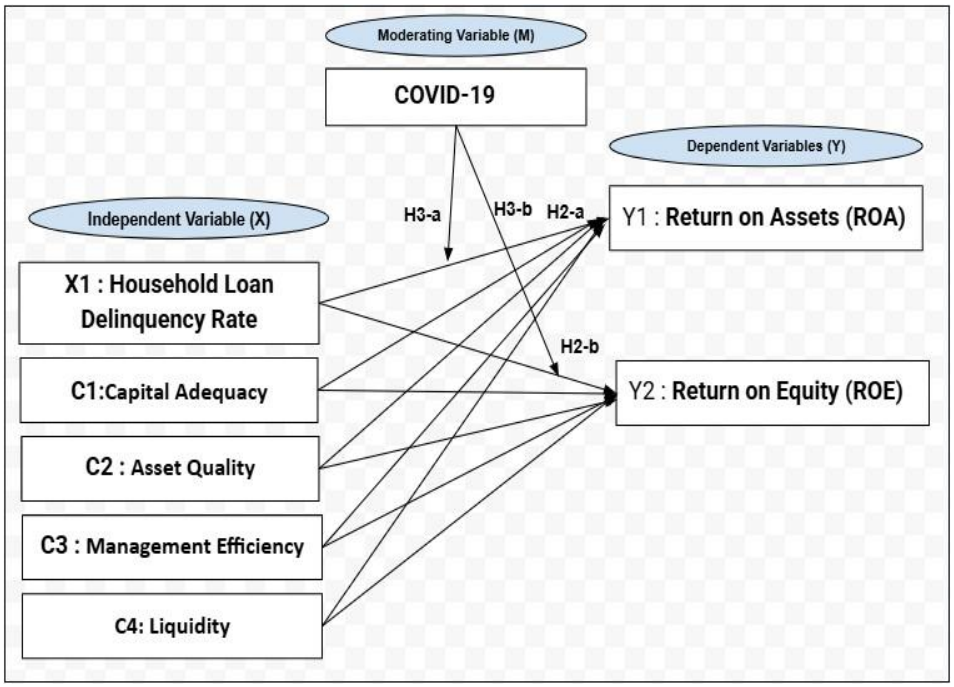

Figure 2-1. Research Framework

Variables:

1. Independent Variable (X): Household Loan Delinquency Rate *(Credit risk exposure measured as percentage of loans overdue by one month or more)*
2. Dependent Variables (Y):

- Return on Assets (ROA) *(Asset efficiency)*
- Return on Equity (ROE) *(Shareholder returns)*

3. Moderating Variable (M): COVID-19
   (Binary indicator: 0 = pre-COVID period 2015–2019; 1 = COVID-19 and post-pandemic period 2020–2024)
4. Control Variables (C):

- Capital Adequacy (C)
- Asset Quality (A)

- Management Efficiency (M)
- Liquidity (L)
- Sensitivity (S) component of CAMELS is excluded to focus on credit-risk-driven effects on profitability.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Design

A research design provides a comprehensive framework that guides data collection and analysis to answer the research questions (Kumar, 2011). This study adopts a quantitative research design, which utilizes numerical data and statistical methods to identify and measure relationships between variables (Rovai et al., 2014).

Specifically, a panel data design is employed to investigate the impact of household loan delinquency rates on the profitability of South Korean commercial banks. The analysis covers annual data from four major banks—KB Kookmin, Shinhan, Hana, and Woori—for the period 2015 to 2024, resulting in a total of 40 observations (4 banks × 10 years). This combined time-series and cross-sectional structure enables the study to capture both changes within banks over time and differences across banks.

The study applies a Pooled Ordinary Least Squares (OLS) regression as the main estimation technique. This method is suitable for examining the average relationship between household loan delinquency and bank profitability while accounting for potential within-bank correlations across the years.

3.2 Measurement of Variables

This study uses three variable types: independent (delinquency rate), dependent (profitability metrics),

and moderating (COVID-19 period), with CAMEL framework components as statistical controls.

3.2.1 Independent Variable

An independent variable is a factor that causes or influences changes in other variables (Kumar, 2011). In this study, the main independent variable is the household loan delinquency rate.

3.2.1.1 Household Loan Delinquency Rate (HDA)

The household loan delinquency rate measures the proportion of household loans overdue by one month or more, expressed as a percentage of total household loans. This indicator serves as an early warning signal of asset quality deterioration, more sensitive than traditional NPL ratios.

When the delinquency rate increases, banks face two major challenges. First, interest income declines as borrowers fail to meet repayment obligations. Second, banks must allocate loan loss provisions—funds set aside to absorb potential losses—which directly reduce profitability. As a result, delinquency rates signal financial stress within the banking system.

The formula is as follows:

$$[\boldsymbol{DEL} = \frac{\textbf{Household loans in default}}{\textbf{Total household loans}} \times \mathbf{100}]$$

A higher delinquency rate indicates a greater level of credit risk in a bank's household loan portfolio.

3.2.2 Dependent Variables

A dependent variable is an outcome that changes based on the independent variable (Hopkins, 2000). This study uses two measures of bank profitability to capture how delinquency affects bank performance.

3.2.2.1 Return on Assets (ROA)

ROA measures how efficiently a bank converts its total asset base into net profit, reflecting management's effectiveness in deploying capital resources.

The formula is as follows:

$$[\boldsymbol{ROA} = \frac{\textbf{Net Income}}{\textbf{Total Assets}} \times \mathbf{100}]$$

A higher ROA signals superior asset utilization, while a lower ROA indicates operational inefficiency. Household loan delinquency adversely affects ROA through two primary mechanisms: (1) increased loan loss provisions reduce net income, and (2) delinquent loans generate reduced interest income relative to performing loans (Athanasoglou et al., 2008).

3.2.2.2 Return on Equity (ROE)

ROE measures the return generated on shareholder capital, reflecting how effectively a bank deploys equity financing to generate profit.

The formula is as follows:

$$[\boldsymbol{ROE} = \frac{\textbf{Net Income}}{\textbf{Shareholders' Equity}} \times \mathbf{100}]$$

Household loan delinquency impacts ROE more severely than ROA due to leverage dynamics. Rising delinquency increases loan loss provisions, reducing both net income and shareholders' equity simultaneously. This dual effect creates a magnified negative impact on ROE, a phenomenon attributable to financial leverage in banking operations (Dietrich & Wanzenried, 2011).

3.2.3 Moderating Variable

A moderating variable is a factor that changes the strength of the relationship between an independent variable and a dependent variable (Sugiyono, 2013). In this study, COVID-19 is the moderating variable.

3.2.3.1 COVID-19

The COVID-19 pandemic represents a structural economic break that fundamentally altered banking sector dynamics. Following the pandemic's onset in early 2020, borrowers faced income disruptions, while extensive government support programs and loan forbearance measures temporarily eased repayment pressures, potentially weakening the conventional delinquency-profitability relationship.

The variable is operationalized as a binary dummy variable to capture this regime shift:

$$\textbf{COVID-19} = \begin{cases} \mathbf{0, if\ year\ is\ 2015–2019\ (Pre-COVID)} \\ \mathbf{1, if\ year\ is\ 2020–2024\ (COVID/Post-COVID)} \end{cases}$$

This classification enables examination of whether pandemic-related policy interventions and subsequent monetary policy normalization changed the delinquency-profitability relationship across these two distinct economic regimes (Holston et al., 2023; Daud et al., 2024).

3.2.4 Control Variables

Control variables are factors included in the regression model to isolate the effect of the independent variable on the dependent variable by holding other potential influences constant (Field, 2013). This study includes four control variables based on the CAMEL framework, which represents key dimensions of bank financial health: Capital adequacy, Asset quality, Management efficiency, and Liquidity.

3.2.4.1 Capital Adequacy Ratio (CAR)

The Capital Adequacy Ratio (CAR) measures a bank's capital strength relative to its risk-weighted assets. A higher CAR indicates a stronger capacity to absorb potential losses, thereby contributing to greater stability in profitability. Formally,

CAR = (Total Regulatory Capital / Risk-Weighted Assets) × 100

CAR is calculated as total regulatory capital divided by risk-weighted assets and expressed as a percentage.

3.2.4.2 Asset Quality (Non-Performing Loan Ratio, NPL)

The Non-Performing Loan (NPL) ratio measures the proportion of loans that are classified as non-performing, typically defined as loans overdue by 90 days or more, relative to total loans. A higher NPL ratio reflects deteriorating asset quality and is expected to negatively affect profitability due to increased loan loss provisioning. Formally,

NPL = (Non-Performing Loans / Total Loans) × 100

3.2.4.3 Management Efficiency (Cost-to-Income Ratio, CIR)

Management efficiency is proxied by the cost-to-income ratio, commonly referred to as CIR in Indonesian banking terminology. This ratio compares operating expenses to operating income. A higher CIR indicates lower managerial efficiency and is expected to have a negative impact on bank profitability. Formally,

CIR = (Operating Expenses / Operating Income) × 100

3.2.4.4 Liquidity (Loan-to-Deposit Ratio, LDR)

The Loan-to-Deposit Ratio (LDR) measures liquidity management by comparing total loans to total customer deposits. This ratio reflects a bank's ability to fund lending activities through deposit financing. While a higher LDR may enhance interest income, excessively high levels can signal increased liquidity risk. Formally,

LDR = (Total Loans / Total Deposits) × 100

By including these CAMEL-based control variables, the study controls for banks' underlying financial conditions, allowing the analysis to isolate the effect of household loan delinquency on profitability.

3.3 Population and Sample

3.3.1 Data Source and Reliability

This study uses official, audited secondary data from three authoritative sources to ensure maximum accuracy and consistency:

Data Sources

1. Financial Supervisory Service (FSS) Bank Management Statistics

The Financial Supervisory Service is the official regulatory body responsible for supervising all financial institutions in South Korea. The FSS collects and publishes standardized financial statistics for all commercial banks, including balance sheets, income statements, and regulatory filings. All data reported to the FSS are audited by independent external auditors, ensuring data integrity and consistency across institutions and time periods.

- Official Website: https://www.fss.or.kr

2. Individual Bank Financial Reports

Financial statements were verified using official Investor Relations (IR) reports published by each of the four major banks. These audited reports contain detailed balance sheets, income statements, and comprehensive disclosures of financial position.

- KB Financial Group: https://www.kbfg.com
- Shinhan Financial Group: https://www.shinhangroup.com
- Hana Financial Group: https://www.hanafn.com
- Woori Bank: https://www.woorifg.com

3. Bank of Korea (BOK) Economic Statistics System (ECOS)

Macroeconomic control variables were obtained from the Bank of Korea's official Economic Statistics System. This database provides official data on interest rates, monetary policy rates, GDP growth, and other economic indicators relevant to the banking sector.

- Official Website: https://ecos.bok.or.kr

Data Quality Assurance

All financial data used in this study are verified by independent external auditors and confirmed by the Financial Supervisory Service before publication. This regulatory oversight ensures the highest level of data reliability and consistency across all observations.

3.3.2 Sampling Method

According to Sugiyono (2017), sampling is the process of selecting a portion of a population to represent the entire population for research purposes. Sampling approaches are broadly categorized into two types: probability sampling, which relies on random selection mechanisms, and non-probability sampling, in which selection is based on specific predetermined characteristics relevant to the research objectives.

This study employs purposive sampling, a type of non-probability sampling in which the researcher deliberately selects samples that best meet the research objectives.

Purposive sampling is particularly appropriate when the researcher possesses specific knowledge about which samples are most relevant to the study and when ensuring data completeness across the observation period is essential (Sugiyono, 2017). This method was chosen to ensure that the selected banks are representative of the South Korean commercial banking sector and possess complete financial data for the entire study period.

3.3.3 Research Population

The research population consists of all commercial banks registered and operating in South Korea. As of 2024, there are 18 commercial banks operating in South Korea, classified by type and size. major commercial banks (nationwide operations), specialized banks (policy-focused), regional banks (geographic limitations), and Internet-only

NO.	BANK NAME	TYPE	Total Assets (Trillion KRW)
1	KB Kookmin Bank	Commercial	638.3
2	Shinhan Bank	Commercial	629.6
3	Hana Bank	Commercial	611.9
4	Woori Bank	Commercial	541.8
5	Industrial Bank of Korea	Specialized	478.9
6	NH Nonghyup Bank	Specialized	463
7	Korea Development Bank	Specialized	368.5

8	Korea EXIM Bank	Specialized	123.2
9	Busan Bank	Regional	95
10	Daegu Bank	Regional	83
11	Suhyup Bank	Specialized	73.6
12	Kyungnam Bank	Regional	61
13	KakaoBank	Internet-only	62.8
14	Kwangju Bank	Regional	36
15	K Bank	Internet-only	31.2
16	Toss Bank	Internet-only	29.7
17	Jeonbuk Bank	Regional	25
18	Jeju Bank	Regional	7.5

Table 3-1. Total Assets of Banks in South Korea
Source: Financial Supervisory Service (FSS)

3.3.4 Sample Selection Criteria

Not all banks in the population meet the requirements for this study. The researcher applied the following five criteria to ensure the sample is appropriate for analyzing the impact of household loan delinquency on bank profitability:

1. Data Completeness

The bank must have published complete annual financial statements for the entire study period (2015–2024) without interruption or missing data.

2. Bank Classification

The bank must be classified as a major commercial bank that operates nationwide under market principles. Banks subject to government policy direction (such as specialized policy banks) are excluded because their lending behavior and profitability are influenced by policy mandates rather than pure market conditions.

3. Household Lending Volume

The bank must maintain a substantial portfolio of household loans (mortgages, consumer loans, etc.). Banks with minimal household lending are excluded because they would not exhibit meaningful variation in delinquency rates.

4. Geographic Coverage

The bank must operate across all regions of South Korea without geographic limitations. Regional banks that serve only specific provinces are excluded because they face different market conditions and economic environments compared to nationwide banks.

5. Systemic Importance

The bank must have total assets exceeding 450 trillion KRW, indicating sufficient size to be affected by and to influence macroeconomic conditions.

3.3.5 Final Research Sample

Applying these five selection criteria, the four major commercial banks qualified for inclusion in this study: KB Financial Group (KB Kookmin Bank), Shinhan Financial Group (Shinhan

Bank), Hana Financial Group (Hana Bank), and Woori Financial Group (Woori Bank).

These four banks collectively hold approximately 65% of all household loans in South Korea and represent the core of the nation's commercial banking sector.

NO.	BANK NAME	TYPE	Total Assets (Trillion KRW)
1	KB Kookmin Bank	Commercial	638.3
2	Shinhan Bank	Commercial	629.6
3	Hana Bank	Commercial	611.9
4	Woori Bank	Commercial	541.8

Table 3-2 : Sample Banks Selected for This Study
Source: Financial Supervisory Service

1.4. Data Analysis Techniques

Data analysis in quantitative research typically involves three key stages: data preparation, statistical testing, and interpretation of results (Marczyk et al., 2005). This study applies descriptive statistics, t-tests, and pooled OLS regression to address the research questions and test the proposed hypotheses.

All data management and statistical analyses are conducted using SPSS Statistics, which provides comprehensive tools for handling panel data, generating descriptive summaries, performing t-tests, and estimating regression models.

3.5 Research Flowchart

This study follows a stepwise empirical procedure to evaluate how the key variables relate to bank performance. After defining and measuring all variables, descriptive statistics are used to summarize their main characteristics. Normality tests are then applied to the profitability measures; if the normality assumption is not rejected, parametric paired t-tests are used, whereas if normality is rejected, the non-parametric Mann-Whitney U test is employed to compare bank performance before and after COVID-19.

Next, the relationship between the independent variable (household loan delinquency rate) and the dependent variables (ROA and ROE) is examined using panel-data regression. Common-effects, fixed-effects, and random-effects specifications are estimated in sequence, and the Chow test, Lagrange Multiplier test, and Hausman test are used to select the most appropriate model. Finally, the chosen regression model is evaluated using t-tests, F-tests, and adjusted R^2, which provide the basis for assessing statistical significance and overall model fit and for interpreting the empirical results.

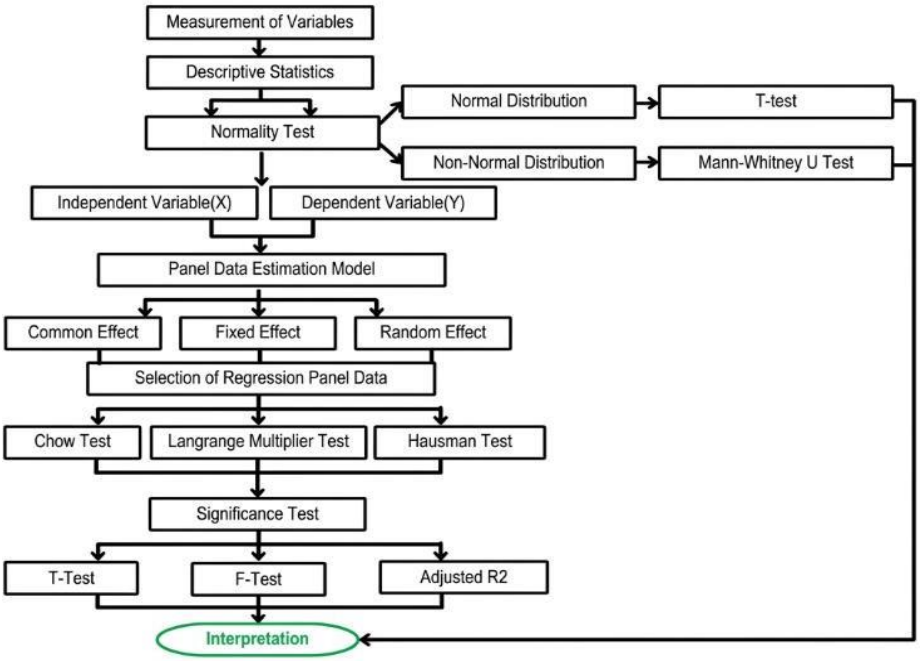

Figure 3-1. 3-1.Data Analysis Flowchart

3.6. Descriptive Statistical Analysis

Descriptive statistics aim to appropriately explain data by carrying out the process of obtaining, presenting, and summarizing various forms of data without attempting to draw generalizations or conclusions that apply to broader populations (Hermawan, 2016). This statistical approach employs numerical methods to transform raw data into meaningful information, thereby facilitating an initial understanding of the dataset prior to inferential analysis (Newbold et al., 2007).

3.6.1. Mean

The mean of a set of quantitative data is calculated as the sum of all observed values divided by the total number of observations in the dataset (McClave et al., 2018). It represents the average level of a variable across all observations.

The formula is as follows :

$$\overline{\boldsymbol{X}} = \frac{\boldsymbol{x_1 + x_2 + x_3 + \cdots + x_n}}{\boldsymbol{n}} = \frac{\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{x_i}}{\boldsymbol{n}}$$

Where:

$\overline{X}$ = Mean

x_i = Value of the ith observation, where $i = 1,2, \ldots, n$

n

$\sum x_i$ = Sum of all observed values

$i=1$

n = Total number of observations

3.6.2 Standard Deviation

Standard deviation is a statistical measure that quantifies the degree of variability or dispersion of data points around the mean. It is defined as the square root of the average squared deviation from the mean and is denoted by the symbol σ.

The formula is as follows :

$$\sigma = \sqrt{\frac{\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} (\boldsymbol{x_i - \bar{x}})^2}{\boldsymbol{n-1}}}$$

Where:

σ = Standard deviation

$\overline{x}$ = Sample mean

x_i = Individual observation

$n =$ Total number of observations

3.6.3 Minimum, Maximum, and Median

The minimum and maximum values define the empirical range of the observed data, indicating the lowest and highest values within the dataset. The median, defined as the middle value when observations are arranged in ascending order, provides a measure of central tendency that is less sensitive to extreme outliers.

For the research variables—Household Loan Delinquency Rate (HDR), Return on Assets (ROA), and Return on Equity (ROE)—these descriptive statistics offer insights into the distributional properties and observed ranges of the data prior to conducting inferential analyses. This foundational step is essential for identifying potential data anomalies and establishing a baseline understanding of the univariate characteristics of each variable.

3.7 Normality Test

In this study, a normality test is conducted to examine whether the main continuous variables—HDR, ROA, and ROE—approximately follow a normal distribution at the bank-year level. The assessment of normality is important because it guides the choice between parametric procedures, such as the paired-sample t-test, and non-parametric alternatives, such as the Mann-Whitney U test, in the preliminary comparison of profitability before and after COVID-19.

For the regression stage, the classical linear model assumes normally distributed errors for exact small-sample t and F statistics, but econometric theory shows that, under standard regularity

conditions and with a sufficiently large sample, OLS estimators remain consistent and asymptotically normal even when the error terms are not perfectly normal. Accordingly, in this study normality tests are used primarily to support the decision between parametric and non-parametric tests in the preliminary analysis, rather than as a strict requirement for the validity of the pooled OLS regression estimates.

3.8 Paired Sample t-Test

This study employs a paired sample t-test (also known as a dependent sample t-test) to examine whether statistically significant differences exist in bank performance before and after the COVID-19 pandemic. The paired sample t-test is appropriate when the same observational units are measured in two related periods, so that each observation in one period has a natural counterpart in the other period and the observations are not independent.

In this study, the same four commercial banks are observed in both the pre-COVID and the COVID/post-COVID periods, which creates a one-to-one pairing for each bank. By focusing on within-bank changes over time, the paired sample t-test controls for time-invariant bank-specific characteristics and isolates the effect of the shock period on profitability.

3.8.1 Research Application

The paired sample t-test is applied to examine changes in bank profitability by comparing the same four banks across two distinct time periods:

- Pre-COVID period: 2015–2019

- COVID/post-COVID period: 2020–2024

For each bank, the test evaluates differences in:

- Return on Assets (ROA)
- Return on Equity (ROE)

For each profitability measure, the average value during the pre-COVID period is paired with the corresponding average value during the COVID/post-COVID period for the same bank. The paired sample t-test then assesses whether the mean differences between the two periods are statistically significant, thereby identifying the impact of COVID-19 on bank profitability over the 2015–2024 period.

3.8.2 Hypothesis Formulation

For bank profitability (ROA and ROE), the hypotheses for the paired sample t-test are specified as follows:

- Null hypothesis (H_0):
  There is no difference in bank profitability (ROA, ROE) before and after COVID-19 (2015–2019 vs. 2020–2024).

- Alternative hypothesis (H_1):
  There is a difference in bank profitability (ROA, ROE) before and after COVID-19 (2015–2019 vs. 2020–2024).

3.8.3 Test Statistic and Decision Criterion

The formula is as follows :

$$\boldsymbol{d_i = X_{i,\text{post}} - X_{i,\text{pre}}}$$

$$\boldsymbol{t = \frac{\overline{d}}{s_d/\sqrt{n}}}$$

where

$\overline{d}$ = Mean of the paired differences

s_d = Standard deviation of the paired difference

n = Number of paired observations

$X_{i,\text{pre}}$ = Value of the variable for bank i in the pre-COVID period

$X_{i,\text{post}}$ = Value of the variable for bank i in the COVID/

post-COVID period

Decision Criterion:

- If p-value < 0.05, the null hypothesis is rejected at the 5% significance level, indicating a statistically significant difference between the pre-COVID ad COVID/post-COVID periods.
- If p-value ≥ 0.05, the null hypothesis is not rejected, indicating no statistically significant difference between the two periods.

A significance level of 0.05 is widely used in social science and financial research, as it provides an appropriate balance between Type I and Type II errors (Newbold et al., 2007).

3.9 Panel Data Regression Analysis

This study uses a pooled Ordinary Least Squares (OLS) panel regression to examine how the household loan delinquency

rate (HDR) affects bank profitability, measured by Return on Assets (ROA) and Return on Equity (ROE). In this framework, each bank-year observation from South Korea's four major commercial banks over the period 2015–2024 is treated as one unit, and a common relationship between delinquency and profitability is estimated across all banks and years. To obtain a cleaner effect of HDR on profitability, the regressions include bank-specific control variables based on the CAMEL framework, capturing capital adequacy, asset quality, management efficiency, earnings quality, and liquidity. A COVID-19 dummy variable and an interaction term between HDR and the COVID-19 period are added in an extended model to assess whether the pandemic altered the impact of delinquency on bank profitability.

3.9..1 Selection of Panel Data Estimation Model

In this study, the choice of panel data model is guided by three common specification tests: the Chow test, the Hausman test, and the Lagrange Multiplier (LM) test.

1. Chow Test

The Chow test, named after econometrician Gregory Chow, is used in this study to assess whether the panel data can be treated as a single pooled sample or whether bank-specific effects need to be taken into account. In practice, the test compares a pooled OLS model with a fixed-effects model by examining whether the intercepts are the same across banks. If the null hypothesis of common intercepts is not rejected at the 5% significance level, the pooled OLS model is judged to be appropriate and is used to estimate the relationship between HDR and bank profitability.

The Chow test statistic is calculated as follows:

$$F = \frac{(\boldsymbol{RSS_P} - (\boldsymbol{RSS_1} + \boldsymbol{RSS_2}))/\boldsymbol{q}}{(\boldsymbol{RSS_1} + \boldsymbol{RSS_2})/(\boldsymbol{NT} - \boldsymbol{2k})}$$

where

RSS_P = residual sum of squares from the pooled regression estimated over 2015–2024,

RSS_1 = residual sum of squares from the regression estimated for the pre-COVID period (2015–2019),

RSS_2 = residual sum of squares from the regression estimated for the COVID/post-COVID period (2020–2024),

q = number of restrictions (the number of coefficients tested for equality across periods),

N = number of banks,

T = number of time periods,

k = number of estimated coefficients in each sub-period regression.

Decision rule for the Chow test

- If p−value < 0.05 → reject H_0 → bank−specific intercepts are different → fixed−effects model is preferred over pooled OLS.
- If p−value ≥ 0.05 → do not reject H_0 → no evidence of different bank−specific intercepts → pooled OLS model can be used.

2. Hausman Test

The Hausman test is a statistical procedure used to determine whether the regression coefficients from the Fixed Effects Model (FEM) and the Random Effects Model (REM) differ systematically. It is widely applied in panel data econometrics when choosing

between FEM, which allows the unobserved individual effects to be

correlated with the regressors, and REM, which assumes no such correlation. The test statistic is calculated as

$$\mathbf{m=(\beta-b)'(M0-M1)-1(\beta-b) \approx X2(K)}$$

where :

β = vector of coefficient estimates from the Fixed Effects Model

b = vector of coefficient estimates from the Random Effects Model

$M0$ = covariance matrix of the FEM estimates

$M1$ = covariance matrix of the REM estimates

The hypotheses for the Hausman test are:

$H0$: Random Effects Model is appropriate (REM is consistent and efficient).

Ha: Fixed Effects Model is preferred (REM is inconsistent, FEM is consistent).

Decision rules are as follows:

* If the p-value < 0.05, reject H0$H0$ and accept HaHa; thus, the Fixed Effects Model is chosen.

* If the p-value > 0.05, do not reject H0$H0$; the Random Effects Model is regarded as more suitable.

3. Lagrange Multiplier (LM) Test

The Lagrange Multiplier (LM) test, also known as the score test, is used in panel data analysis to decide whether a Random Effects Model (REM) is preferable to a Common Effect (pooled OLS) model. The test examines whether there is significant variance in the composite error term across cross-sectional units beyond what is captured by the pooled OLS residuals. A significant LM statistic indicates that random effects are present and that the pooled model is too restrictive.

$$LM = \frac{NT}{2(T-1)}\left(\frac{\sum_{i=1}^{N}\left(\sum_{t=1}^{T} e_{it}\right)^2}{\sum_{i=1}^{N}\sum_{t=1}^{T} e_{it}^2} - 1\right)$$

Where:

N = number of cross-sectional units (banks)

T = number of time periods

eit = residuals from the pooled OLS (Common Effect) model

The hypotheses for the LM test are:

*H*0: Common Effect (pooled OLS) model is adequate.

Ha: Random Effects Model is preferred.

Decision rules:

* If the p-value < 0.05, reject H0*H*0 and conclude that the Random Effects Model is better than the Common Effect Model.

* If the p-value > 0.05, do not reject H0*H*0 and retain the Common Effect Model as more appropriate

3.9.2 Regression Assumptions

The pooled OLS regression models rely on the standard assumptions of linear regression.

1. Linearity

The relationship between household loan delinquency (HDR) and bank profitability (ROA and ROE) is assumed to be linear, conditional on the control variables. Linearity is checked by inspecting scatter plots and residual plots between the fitted values and the dependent variables.

2. No perfect multicollinearity

The explanatory variables, including the CAMEL control ratios and the COVID-19 dummy, are assumed not to be perfectly correlated with each other. This assumption is evaluated using the Variance Inflation Factor (VIF) for each regressor:

a. If VIF ≤ 10, the null hypothesis of no serious multicollinearity is not rejected.
b. If VIF > 10, the alternative hypothesis of problematic multicollinearity is supported.

3. No serial correlation

The error term is also assumed to exhibit no serial correlation within banks over time. The Durbin–Watson statistic is obtained from the linear regression output in SPSS and used as a diagnostic for

first-order autocorrelation; the following decision rule is applied:

a. If the Durbin–Watson value is close to 2, the null hypothesis of no serious first-order autocorrelation in the residuals is not rejected.
b. If the Durbin–Watson value is far from 2, the presence of first-order autocorrelation is suspected and the no-serial-correlation assumption may be violated.

3.9.3 Model Specification

Two regression models are specified to test the hypotheses. Model 1 estimates the baseline relationship between household loan delinquency and bank profitability, while Model 2 adds a COVID-19 dummy variable and an interaction term to capture the moderating effect of the pandemic.

* Model 1: Main Effects Model

$$ROA_{it} = \beta_0 + \beta_1 HDR_{it} + \gamma_1 CAR_{it} + \gamma_2 NPL_{it} + \gamma_3 CIR_{it} + \gamma_4 LDR_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 HDR_{it} + \gamma_1 CAR_{it} + \gamma_2 NPL_{it} + \gamma_3 CIR_{it} + \gamma_4 LDR_{it} + \varepsilon_{it}$$

* Model 2: Moderated Model with COVID-19 Interaction

$$ROA_{it} = \beta_0 + \beta_1 HDR_{it} + \beta_2 COVID_t + \beta_3 (HDR_{it} \times COVID_t) + \gamma_1 CAR_{it} + \gamma_2 NPL_{it} + \gamma_3 CIR_{it} + \gamma_4 LDR_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 HDR_{it} + \beta_2 COVID_t + \beta_3 (HDR_{it} \times COVID_t) + \gamma_1 CAR_{it} + \gamma_2 NPL_{it} + \gamma_3 CIR_{it} + \gamma_4 LDR_{it} + \varepsilon_{it}$$

Where:

ROAit = Return on Assets of bank i at time t

ROEit = Return on Equity of bank i at time t

DELit = Household loan delinquency rate of bank i at time t

CARit = Capital Adequacy Ratio of bank i at time t

NPLit = Non-Performing Loan ratio of bank i at time t

CIRit = Cost-to-Income ratio (CIR) of bank i at time t

LDRit = Loan-to-Deposit Ratio of bank i at time t

COVIDt = Covid-19 dummy (0 = pre-Covid period, 1 = Covid period)

$\beta 0, \beta 1, \beta 2, \beta 3, \gamma 1, \gamma 2, \gamma 3, \gamma 4$ =Regression coefficients

εit = Error term of bank i at time t

3.9.4 Variable Definitions and Coefficient Interpretation

In the pooled OLS models, bank profitability is measured by ROA and ROE, defined as returns on total assets and shareholders' equity. The main explanatory variable is the household loan delinquency rate (HDR), and COVID is a dummy equal to 0 for 2015–2019 and 1 for 2020–2024. CAMEL-based controls (CAR, NPL, CIR, LDR) are included to capture bank-level differences in capital adequacy, asset quality, management efficiency, and liquidity.

The intercep0 represents the baseline level of profitability when HDR, COVID, and the controls are at their reference values. The coefficient $\beta 1$ captures the effect of HDR on profitability in the pre-COVID period (*COVID*=0). The coefficient $\beta 2$ measures the average change in profitability in the COVID/post-COVID period relative to the pre-COVID period, and $\beta 3$ reflects how the effect of

HDR differs during the COVID/post-COVID period, so that the marginal effect of HDR under COVID is $\beta 1+\beta 3$. The coefficients $\gamma 1–\gamma 4$ represent the partial effects of CAR, NPL, CIR, and LDR on profitability.

3.9.5 Statistical Significance Testing

1. Individual Significance (t-Test)

Individual regression coefficients are tested for statistical significance at the 0.05 significance level (95% confidence), using the following t-statistic:

$$t = \frac{\beta_j}{SE(\beta_j)}$$

where:

$\beta_j =$ Estimated regression coefficient

$SE(\beta_j) =$ Standard error of the regression coefficient β_j

Decision criterion:

- If the p-value is less than 0.05, the regression coefficient is statistically significant at the 5% level, indicating a meaningful and reliable relationship between the independent variable and the dependent variable.

- If the p-value is greater than or equal to 0.05, the regression coefficient is not statistically significant, suggesting that the observed relationship may be attributable to random variation.

2. **Simultaneous Test (F-test)**

The overall (simultaneous) significance of the regression model is evaluated using an F-test, which examines whether the set of independent variables, taken together, has explanatory power for the dependent variable. This test focuses on the joint significance of all slope coefficients rather than on each coefficient individually.

The hypotheses are specified as follows:

- *H*0: All slope coefficients of the independent variables are equal to zero.
- *Ha*: At least one slope coefficient is different from zero.

Decision criterion:

- If the p-value of the F-statistic is less than 0.05, *H*0 is rejected. This indicates that the independent variables jointly have a statistically significant effect on the dependent variable and that the regression model is meaningful as a whole.
- If the p-value of the F-statistic is greater than or equal to 0.05, *H*0 is not rejected. This implies that there is insufficient evidence at the 5% level to conclude that the independent variables collectively influence the dependent variable.

3. **Coefficient of Determination (Adjusted R^2)**

The adjusted coefficient of determination (Adjusted R^2) is used to assess the explanatory power of the regression model while accounting for the number of independent variables included. By penalizing the addition of irrelevant predictors, Adjusted R^2provides

a more reliable indicator of model fit in multiple regression than the ordinary R^2.

In this study, the Adjusted R^2reflects the proportion of variation in bank profitability (ROA or ROE) that can be explained by household loan delinquency, the COVID-19 dummy, and the CAMEL-based control variables. A larger Adjusted R^2 value indicates that these variables collectively capture more of the fluctuations in bank performance, whereas a smaller value suggests that the model has limited explanatory power.

CHAPTER 4

FINDINGS, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the empirical results of the study. Descriptive statistics, paired-sample t-tests, Chow tests, and pooled panel regressions are conducted using SPSS on annual data for the four largest Korean commercial banks over the period 2015–2024.

The analysis addresses two main questions: first, how household loan delinquency rates affect bank profitability, measured by ROA and ROE; and second, whether this effect changes during the COVID-19 period. To control for differences in capital strength, asset quality, efficiency, and liquidity across banks and over time, CAMEL-type bank indicators (CAR, NPL ratio, cost-to-income ratio, and LDR) are incorporated as control variables

4.2 Data Collection and Descriptive Statistics

Before the analysis, the raw data were checked and cleaned, and basic descriptive statistics were produced. The sample consists of annual observations for KB Kookmin Bank, Shinhan Bank, Hana Bank, and Woori Bank from 2015 to 2024. The financial and risk indicators used in this chapter—household loan delinquency rate (HLDR), ROA, ROE, CAR, NPL, CIR, and LDR—are defined in Chapter 3 and follow standard banking practice.

4.3 Descriptive Statistical Analysis

Descriptive statistics provide a simple summary of the data by reporting measures of central tendency and dispersion, such as the mean, minimum, maximum, and standard deviation for each variable. Table 4.1 and Table 4.2 report these descriptive statistics for all variables before COVID-19 (2015–2019) and after COVID-19 (2020–2024)

Variable	Division	Mean	Std. Deviation	Skewness	Kurtosis	Minimum	Maximum
Independent	HDR	0.25	0.07	0.23	-0.48	0.14	0.39
Dependent	ROA	0.52	0.16	-0.86	-0.08	0.16	0.73
	ROE	7.11	2.12	-0.99	-0.16	2.59	9.33
Control	CAR	15.60	0.64	-1.74	3.52	13.66	16.32
	NPL	0.70	0.30	1.11	0.79	0.37	1.47
	CIR	55.93	6.73	1.00	1.10	47.02	73.39
	LDR	98.06	3.46	2.86	10.86	94.00	111.00

Table 4-1. Descriptive Statistics of financial **(COVID_Pre)**

Variable	Division	Mean	Std. Deviation	Skewness	Kurtosis	Minimum	Maximum
Independent	HDR	0.21	0.05	-0.40	-0.90	0.11	0.28
Dependent	ROA	0.58	0.07	-1.00	2.48	0.38	0.70
	ROE	8.92	1.38	-0.25	-0.08	5.83	11.09
Control	CAR	17.16	0.99	-0.99	0.32	14.73	18.47
	NPL	0.26	0.05	0.33	-0.91	0.18	0.36
	CIR	47.05	4.80	0.72	1.50	38.28	59.78
	LDR	96.16	2.55	-0.42	-0.44	91.00	100.00

Table 4-2. Descriptive Statistics of financial **(COVID_Post)**

For household loan delinquency and profitability, the main patterns are as follows:

(1) HDR: The mean decreases from 0.25 to 0.21 and the standard deviation from 0.07 to 0.05, indicating lower and more stable delinquency rates after COVID-19.

(2) ROA: The average increases slightly from 0.52 to 0.58, while the standard deviation falls from 0.16 to 0.07, suggesting higher and more stable profitability.

(3) ROE: The mean rises from 7.11 to 8.92 and its dispersion declines from 2.12 to 1.38, implying improved and less volatile returns on equity.

For the control variables:

(1) CAR: The mean increases from 15.60 to 17.16, showing that banks maintain stronger capital buffers in the post-COVID period.

(2) NPL: The mean drops sharply from 0.70 to 0.26 and becomes less dispersed, pointing to an overall improvement in asset quality.

(3) CIR: The mean declines from 55.93 to 47.05, indicating better cost efficiency.

(4) LDR: The mean decreases slightly from 98.06 to 96.16, reflecting a somewhat more conservative loan-to-deposit position.

Overall, the post-COVID period is characterized by lower HDR and NPL, higher CAR and profitability (ROA and ROE), and reduced CIR and LDR, suggesting that the four major Korean commercial banks exhibit a more stable and conservative financial condition after COVID-19

4.4 Differences in Bank Profitability Before and After COVID-19

4.4.1 Normality test for paired differences

To examine whether ROA and ROE differ before and after the COVID-19 period, this study applies a paired-sample t-test. Since this test requires the paired differences to follow a normal distribution, the normality of the difference scores is first checked using the Kolmogorov–Smirnov and Shapiro–Wilk tests at the 0.05 significance level. When the p-value is at least 0.05, the normality assumption is regarded as fulfilled, whereas a p-value below 0.05 indicates that the assumption is not fulfilled

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
ROA_Diff	.135	20	.200*	.941	20	.248
ROE_Diff	.127	20	.200*	.935	20	.192

Table 4-3. Results of normality tests for ROA and ROE

The p-values for ROA_Diff are 0.200 (Kolmogorov–Smirnov) and 0.248 (Shapiro–Wilk), while those for ROE_Diff are 0.200 and 0.192, respectively, all of which are greater than 0.05. Hence, the normality assumption is fulfilled for the differences in both ROA and ROE, so it is appropriate to continue with the paired-sample t-test.

4.4.2 Paired-sample t-test for profitability

This subsection tests whether bank profitability is different before and after the COVID-19 period. A paired-sample t-test is applied to compare the mean values of ROA and ROE for the same banks in the pre-COVID (2015–2019) and COVID/post-COVID (2020–2024) periods, using a 5 percent significance level.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	ROA_PRE - ROA_POST	-.05750	.12993	.02905	-.11831	.00331	-1.979	19	.062
Pair 2	ROE_PRE - ROE_POST	-1.81450	1.73980	.38903	-2.62875	-1.00025	-4.664	19	.000

Table 4-4. Paired-t-test results for ROA and ROE

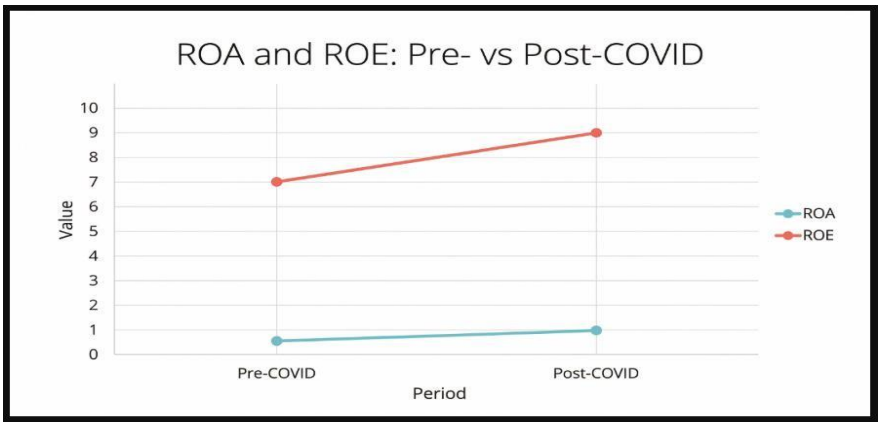

Figure 4-1. Paired t-test results for ROA and ROE

For ROA, the mean increases from 0.5185 in the pre-COVID period to 0.5760 in the COVID/post-COVID period. The paired-sample t-test reports a mean difference of −0.0575 (ROA_PRE − ROA_POST), with a t-value of −1.979 and a two-tailed p-value of 0.062. Because the p-value is greater than 0.05, the change in ROA is not statistically significant.

For ROE, the mean rises from 7.1085 to 8.9230 between the two periods. The mean difference of −1.8145 (ROE_PRE − ROE_POST) yields a t-value of −4.664 and a p-value of 0.000, which is less than 0.05. Therefore, the change in ROE is statistically significant, indicating that bank profitability measured by ROE improves in the COVID/post-COVID period compared with the pre-COVID period. Overall, the paired-sample t-test shows a significant increase in ROE but only a non-significant increase in ROA across the two periods.

4.5 Panel Data Regression

4.5.1 Choosing Panel Data Regression Model

For the empirical analysis, this study employs panel (longitudinal) data, which consist of repeated observations on the same banks over several years. Such data combine cross-sectional and time-series information and therefore require an appropriate panel estimation technique. As outlined in Chapter 3, three specification tests are used to determine the most suitable model: the Chow test, the Hausman test, and the Lagrange Multiplier (LM) test. The panel dataset is first structured according to the analytical framework and then assessed using these tests to select the preferred regression specification.

ROA Effect Test	Statistic	d.f.	Prob.
Structural Change F	1.250	6, 28	0.304

ROE Effect Test	Statistic	d.f.	Prob.
Structural Change F	5.190	6, 28	0.07

Table 4-5. The Result of Chow Test

The Chow test comparing the Common-Effect Model (CEM) and the Fixed-Effect Model (FEM) yields a p-value greater than 0.05. This indicates that the null hypothesis cannot be rejected and that the CEM is more appropriate than the FEM for this dataset.

Because this study includes only 4 banks but uses 5 independent variables (including control variables), the Random-Effects Model (REM) is not employed and model comparisons involving REM are not performed, as with very few cross-sectional units the variance of random effects and associated parameters cannot be estimated with sufficient reliability in applied panel settings.

Table4-6. Result of Panel Data Model Selection

Test	Compared Models	Preferred Model
Chow test	CEM vs. FEM	CEM
Hausman test	FEM vs. REM	x
Lagrange Multiplier test	CEM vs. REM	x

-CEM = Common-Effect Model

-FEM = Fixed-Effect Model

-REM = Random-Effect Model

4.5.2 Regression results

This section presents the empirical regression results for bank profitability using ROA and ROE as dependent variables. The models are estimated with panel data and include both bank-specific variables and the COVID-19 dummy to capture the impact of the pandemic period.

4.5.1 Regression results for ROA

Model 1 presents the baseline regression of ROA on HDR and the control variables, without the COVID-19 dummy and the interaction term. The model shows moderate to high explanatory power ($R^2 = 0.649$, adjusted $R^2 = 0.597$), and the F-statistic is significant ($F = 12.573$, $p < 0.001$), so the overall model is statistically valid. The Durbin–Watson statistic is 1.739, which is close to 2, inicating no serious autocorrelation in the residuals.

Model		ROA						
		B	SE	β	t	p	Tolerance	VIF
1	(Constant)	.781	.465		1.680	.102		
	HDR	-.142	.227	-.074	-.628	.534	.749	1.336
	CAR	-.022	.015	-.203	-1.499	.143	.564	1.773
	NPL	-.202	.070	-.506	-2.879**	.007	.335	2.988
	CIR	-.008	.003	-.500	-3.270**	.002	.442	2.263
	LDR	.007	.004	.181	1.597	.120	.799	1.251
		R^2=.649, adjR^2=.597, F=12.573, p=.000, Durbin-Watson=1.739						
2	(Constant)	.885	.324		2.733	.010		
	HDR(A)	-.079	.154	-.041	-.512	.612	.743	1.346
	CAR	.007	.012	.069	.646	.523	.412	2.426
	NPL	-.314	.051	-.787	-6.174***	.000	.289	3.457
	CIR	-.010	.002	-.586	-5.510***	.000	.416	2.404
	LDR	.003	.003	.081	.969	.340	.671	1.490
	COVID_Period(B)	-.179	.032	-.733	-5.662***	.000	.281	3.565
	AxB	.080	.348	.020	.230	.820	.649	1.541
		R^2=.849, adjR^2=.817, F=25.794, p=.000, Durbin-Watson=1.739						

*p<.05, **p<.01, ***p<.001

Table 4-7. Regression results for ROA

1. HDR (household loan delinquency ratio): The coefficient is negative (B = −0.142) but not statistically significant (p = 0.534), so changes in household loan delinquency do not have a clear effect on ROA in Model 1.

2. CAR (capital adequacy ratio): The coefficient is negative (B = −0.022) and not significant (p = 0.143), meaning that capital adequacy does not show a reliable influence on ROA.

3. NPL (non-performing loan ratio): The coefficient is negative and significant (B = −0.202, p = 0.007), so a higher NPL ratio

significantly reduces ROA and credit risk is an important driver of bank profitability.

4. CIR (operating expense to operating income ratio): The coefficient is negative and significant (B = −0.008, p = 0.002), which implies that lower cost efficiency (higher CIR) is associated with lower ROA.

5. LDR (loan-to-deposit ratio): The coefficient is positive (B = 0.007) but not significant (p = 0.120), so LDR does not have a clear marginal effect on ROA in the baseline model.

Regarding multicollinearity and residuals, all VIF values are between 1.251 and 2.988 and all tolerance values are above 0.3, which are within commonly accepted thresholds (VIF < 5–10, tolerance > 0.1). Therefore, multicollinearity is not a serious issue and the coefficients in Model 1 can be considered reliable

Model2 extends the baseline specification by adding the COVID_Period dummy and the interaction term HDR×COVID_Period to capture the moderating effect of the COVID-19 period on the relationship between HDR and ROA. The explanatory power increases substantially (R^2= 0.849, adjusted R^2= 0.817), and the F-statistic remains highly significant (F = 25.794, p = 0.000), so Model 2 fits the data better than Model 1. The Durbin–Watson statistic is again 1.739, still close to 2, indicating no strong evidence of autocorrelation.

1. HDR (A): The coefficient is negative (B = −0.079) but not statistically significant (p = 0.612), so even after including the

COVID-19 dummy, the stand-alone effect of household loan delinquency on ROA is not confirmed in Model 2.

2. CAR: The coefficient becomes slightly positive (B = 0.007) but remains not significant (p = 0.523), indicating that capital adequacy still does not have a meaningful impact on ROA in the adjusted model.

3. NPL: The coefficient becomes more negative and remains highly significant (B = −0.314, p = 0.000), suggesting that higher credit risk sharply reduces bank profitability and that NPL is a strong determinant of ROA in Model 2.

4. CIR: The coefficient is also negative and highly significant (B = −0.010, p = 0.000), confirming that cost inefficiency continues to have a strong adverse effect on ROA.

5. LDR: The coefficient is positive (B = 0.003) but not significant (p = 0.340), so as in Model 1, the loan-to-deposit ratio does not have a statistically clear effect on ROA.

6. COVID_Period (B): The coefficient is negative and highly significant (B = −0.179, p = 0.000), which means that, after controlling for loan quality and bank-specific factors, the COVID-19 period is associated with a significantly lower level of ROA, indicating an adverse period effect on bank profitability.

7. HDR×COVID_Period (A×B): The coefficient is positive (B = 0.080) but far from significant (p = 0.820), implying that the impact of household loan delinquency on ROA does not differ significantly between the pre-COVID and COVID periods.

In Model 2, VIF values range from 1.346 to 3.565 and tolerance values remain well above 0.1, which are acceptable for regression analysis. Thus, multicollinearity is still not a major concern and the coefficient estimates of the adjusted model are stable and reliable.

4.5.2 Regression results for ROE

Model 1 presents the baseline regression of ROE on HDR and the CAMEL-based control variables, without the COVID-19 dummy and the interaction term. The model shows high explanatory power ($R^2 = 0.831$, adjusted $R^2 = 0.806$), and the F-statistic is significant ($F = 33.416$, $p < 0.001$), which indicates that the overall model is statistically valid. The Durbin–Watson statistic is 1.913, close to 2, suggesting that there is no serious autocorrelation problem in the residuals.

Model		ROE						
		B	SE	β	t	p	Tolerance	VIF
1	(Constant)	24.848	5.190		4.788	.000		
	HDR	3.268	2.532	.105	1.291	.206	.749	1.336
	CAR	-.414	.164	-.237	-2.522*	.017	.564	1.773
	NPL	-4.276	.782	-.666	-5.465***	.000	.335	2.988
	CIR	-.135	.029	-.495	-4.669***	.000	.442	2.263
	LDR	-.019	.050	-.029	-.372	.712	.799	1.251
		R^2=.831, adjR^2=.806, F=33.416, p=.000, Durbin-Watson=1.913						
2	(Constant)	26.097	4.560		5.723	.000		
	HDR(A)	3.750	2.165	.121	1.732	.093	.743	1.346
	CAR	-.149	.164	-.086	-.914	.368	.412	2.426
	NPL	-5.245	.717	-.817	-7.315***	.000	.289	3.457
	CIR	-.149	.025	-.547	-5.869***	.000	.416	2.404
	LDR	-.057	.046	-.090	-1.231	.227	.671	1.490
	COVID_Period(B)	-1.563	.446	-.398	-3.506**	.001	.281	3.565
	AxB	-1.076	4.898	-.016	-.220	.827	.649	1.541
		R^2=.885, adjR^2=.859, F=35.021, p=.000, Durbin-Watson=1.913						

*p<.05, **p<.01, ***p<.001

Table 4-8. Regression results for ROE

1. HDR (household loan delinquency ratio): The coefficient is positive (B = 3.268) but not statistically significant (p = 0.206), so changes in household loan delinquency do not have a clear effect on ROE in Model 1.

2. CAR (capital adequacy ratio): The coefficient is negative and significant (B = −0.414, p = 0.017), implying that higher capital adequacy is associated with lower ROE, which may reflect a trade-off between capital buffers and shareholder returns.

3. NPL (non-performing loan ratio): The coefficient is negative and highly significant (B = −4.276, p = 0.000), indicating that an increase in NPL strongly reduces ROE and that credit risk is a key determinant of bank profitability in terms of equity returns.

4. CIR (Cost-to-Income ratio) : The coefficient is negative and highly significant (B = −0.135, p = 0.000), which suggests that lower cost efficiency (higher CIR) leads to lower ROE.

5. LDR (loan-to-deposit ratio): The coefficient is negative (B = −0.019) but not significant (p = 0.712), so the loan-to-deposit ratio does not have a statistically clear marginal effect on ROE in the baseline model.

With respect to multicollinearity, all VIF values in Model 1 range from 1.251 to 2.988 and all tolerance values are above 0.3, which are within commonly accepted thresholds (VIF < 5–10, tolerance > 0.1). Therefore, multicollinearity is not a serious issue and the coefficients can be considered reliable.

Model 2 extends the baseline specification by adding the COVID_Period dummy and the interaction term HDR×COVID_Period to capture the moderating effect of the COVID-19 period on the relationship between HDR and ROE. The explanatory power increases from 0.831 to 0.885 (adjusted R^2 from 0.806 to 0.859), and the change in R^2 is statistically significant (F-change = 7.431, p = 0.002), indicating that Model 2 fits the data better than Model 1. The Durbin–Watson statistic remains at 1.913, still close to 2, so there is no evidence of serious autocorrelation.

1. HDR (A): The coefficient is positive (B = 3.750) and its p-value (0.093) is slightly above the 5% threshold, meaning that HLDR has a positive but not statistically confirmed effect on ROE in Model 2.

2. CAR: The coefficient becomes smaller in magnitude and is no longer significant (B = −0.149, p = 0.368), indicating that, after including the COVID-19 dummy and the interaction term, capital adequacy does not have a meaningful impact on ROE.

3. NPL: The coefficient is more negative and remains highly significant (B = −5.245, p = 0.001), suggesting that higher credit risk sharply reduces ROE and that NPL is a very strong determinant of equity profitability in the adjusted model.

4. CIR: The coefficient is also negative and highly significant (B = −0.149, p = 0.001), confirming that cost inefficiency continues to exert a strong adverse effect on ROE.

5. LDR: The coefficient remains negative and not significant (B = −0.057, p = 0.227), so the loan-to-deposit ratio still does not show a statistically clear effect on ROE.

6. COVID_Period (B): The coefficient is negative and statistically significant (B = −1.563, p = 0.001), which means that, after controlling for bank-specific factors, the COVID-19 period is associated with a significantly lower level of ROE, indicating an adverse period effect on shareholders' returns.

7. HDR×COVID_Period (A×B): The interaction term has a negative but insignificant coefficient (B = −1.076, p = 0.827), implying that the effect of household loan delinquency on ROE

does not differ significantly between the pre-COVID and COVID periods.

In Model 2, VIF values range from 1.346 to 3.565 and tolerance values are all above 0.28, which are acceptable for regression analysis. Thus, multicollinearity is still not a major concern and the coefficient estimates of the adjusted ROE model are stable and reliable.

4.6 Test of hypotheses results

This section summarizes the hypothesis testing results based on the t-tests and panel regression models for ROA and ROE. Each hypothesis is evaluated at the 5% significance level by comparing the estimated p-values with the 0.05 threshold and examining whether the hypothesized effects are supported or rejected.

H1: There is a difference in bank profitability (ROA, ROE) before and after COVID-19 (2015–2019 vs. 2020–2024).

- Result: The paired t-test shows that the mean ROE is significantly higher in the post-COVID period than in the pre-COVID period ($p < 0.001$), while the increase in ROA is not statistically significant ($p = 0.062$). Accordingly, the overall hypothesis that bank profitability differs before and after COVID-19 is only partially supported, as the difference is confirmed for ROE but not for ROA.

H2: Household loan delinquency rates have a negative effect on bank profitability.

- H2-a: Household loan delinquency rates have a negative effect on Return on Assets.
  Result: In the ROA baseline model, the coefficient of HDR is negative (B = −0.142) but statistically insignificant (p = 0.534), which is above the 5% significance level. Therefore, the expected negative effect of household loan delinquency rates on ROA is not supported, and H2-a is rejected.

- H2-b: Household loan delinquency rates have a negative effect on Return on Equity.
  Result: In the ROE baseline model, HDR has a positive but insignificant coefficient (B = 3.268, p = 0.206). Since the sign is opposite to the hypothesized negative effect and the coefficient is not statistically significant at the 5% level, the hypothesis that higher household loan delinquency rates reduce ROE is not supported, and H2-b is rejected.

H3: COVID-19 moderates the effect of household loan delinquency rates on bank profitability.

- H3-a: COVID-19 moderates the effect of household loan delinquency rates on Return on Assets.
  Result: In the ROA extended model, the interaction term HDR×COVID_Period has an insignificant coefficient (B = 0.080, p = 0.820). This indicates that the impact of household loan delinquency rates on ROA does not differ significantly between the pre- and post-COVID-19 periods, so H3-a is not supported.

- H3-b: COVID-19 moderates the effect of household loan delinquency rates on Return on Equity.

Result: In the ROE extended model, the interaction term HDR×COVID_Period is also insignificant (B = −1.076, p = 0.827). Thus, COVID-19 does not significantly change the relationship between household loan delinquency rates and ROE, and H3-b is not supported.

4.7 Summary of results

Summarizes the hypothesis testing results and links them to the main empirical evidence from the t-tests and panel regressions for ROA and ROE

Hypothesis	Main result	Decision
H1	Bank profitability (ROA,ROE) between pre-COVID and COVID/post	Partially supported (only ROE)
H2-a	HDR effect on ROA is not significant	Not supported
H2-b	HDR effect on ROE is not significant	Not supported
H3-a	COVID does not change HDR–ROA relationship	Not supported
H3-b	COVID does not change HDR–ROE relationship	Not supported

Table 4-10. Summary of Hypothesis Testing Results

CHAPTER 5

CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

5.1 conclusion

The study addresses the question of whether the household loan delinquency rate affects the profitability of Korea's commercial banks before and after COVID-19, and how this relationship is shaped by selected control variables such as NPL, CIR, CAR, and LDR, using annual financial statement data for four major commercial banks over the period 2015–2024 with a common-effect panel model.

1. The difference in bank profitability before and during COVID-19.

H1 is partially supported: bank profitability differs between the pre-COVID and COVID periods when measured by ROE, but not when measured by ROA. This indicates that returns to equity holders declined under COVID-19, while the earning capacity of bank assets remained relatively stable.

2. The effect of HDR and control variables on bank profitability.

H2 is not supported for HDR: the household loan delinquency rate does not show a clear effect on either ROA or ROE, which may reflect policy support measures and risk management practices that

weakened the transmission of household delinquencies to bank profits.

Instead, NPL and CIR emerge as the main drivers of bank profitability, indicating that asset quality and operating efficiency are key determinants of performance, while CAR and LDR appear to play only a limited role within the range observed in this sample.

3. The different effect of HDR on bank profitability before and during COVID-19

The COVID-19 dummy points to lower bank profitability during the COVID period, indicating an overall decline in performance under pandemic conditions.

However, the interaction term HDR×COVID does not show a meaningful additional effect, implying that COVID-19 reduces the general level of profitability but does not materially change the relationship between household loan delinquency and bank profitability.

5.2 Practical and theoretical implications

From a theoretical perspective, the findings show that household loan delinquency is not a primary driver of bank profitability for large Korean commercial banks, whereas NPL and CIR provide a much stronger explanation of variation in ROA and ROE. This highlights the importance of distinguishing between flow-type delinquency indicators and stock-type credit risk (NPL) measures and incorporating cost efficiency explicitly into profitability models.

For banks, the results suggest that the main threats to profitability arise from the build-up of non-performing loans and persistent operating inefficiency, rather than from headline household delinquency rates alone. Strengthening credit risk management, accelerating NPL resolution, and improving cost control should therefore be prioritized over simply tightening household lending standards. The negative and significant COVID-19 effect also indicates the need for contingency planning and sufficient capital and liquidity buffers to absorb profitability shocks during crises.

For regulators and policymakers, the evidence implies that macroeconomic disruptions such as COVID-19 can depress bank profitability even when observed delinquency ratios appear stable. Prudential and macroprudential policies should therefore pay close attention to NPL dynamics and banks' cost structures, in addition to traditional indicators such as capital adequacy and liquidity. Crisis-response measures should be designed in a way that prevents a delayed deterioration in asset quality and profitability once temporary support and regulatory forbearance are withdrawn.

5.3 Limitations and suggestions for future research

This study has several limitations. First, the analysis is restricted to four large commercial banks, which limits the generalizability of the results to smaller banks, regional institutions, and non-bank financial intermediaries. Second, the use of pooled OLS with annual data may not fully capture bank-specific unobserved heterogeneity or short-term dynamics in the adjustment of delinquency and profitability. Third, within the CAMELS

framework, the Sensitivity to market risk (S) component is excluded because this study focuses on credit-risk-related factors, so market risk is kept outside the main analysis

Future research could extend the observation period or employ higher-frequency data to examine more finely how household loan delinquency and profitability adjust before, during, and after crisis episodes. Additional variables, such as detailed household debt composition, loan restructuring programs, market-risk indicators corresponding to the S component of CAMELS, and broader macroeconomic indicators, could be incorporated to better understand why delinquency does not show a direct effect while NPL and CIR do. Finally, expanding the sample to include a wider range of financial institutions and applying alternative panel techniques, such as fixed-effects or dynamic panel models, would allow a more comprehensive assessment of whether the patterns identified for the four major commercial banks hold across different business models and risk profiles.

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