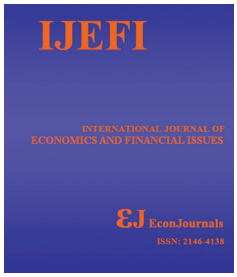

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The Impact of Asset-Liability Management on the Profitability of Listed Commercial Banks in Vietnam

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ABSTRACT

This paper investigates the effect of asset-liability management on the profitability of listed commercial banks in Vietnam, analyzing annual data from 2013 to 2023. The study uses VIF tests, Heteroskedasticity tests, Model Specification tests, and the Generalized Least Squares (GLS) model with the Modified Wald test to examine the data. The results reveal a positive correlation between bank asset management and annual GDP growth with profitability. Conversely, liability management and the year-on-year growth rate of total assets negatively impact profitability. Specifically, factors such as loans and advances, investments in securities on the asset side, and deposits and borrowings from other credit institutions, along with customer deposits on the liability side, are significant. Lending activities, in particular, are identified as key drivers of financial performance in the Vietnamese banking sector. However, the minimal impact of investment securities on profitability raises questions, given their traditionally significant role in banking profitability strategies globally. The study also highlights the negative effects of certain liabilities on bank profitability, stressing the need for careful liability management for banks in Vietnam. While GDP growth is generally linked with economic prosperity and financial sector growth, its impact on bank profitability in Vietnam appears limited, suggesting that other factors might play a more significant role.

Keywords: Asset-Liability Management, Profitability, Commercial Banks, Vietnam
JEL Classifications: C23, G21, G22

1. INTRODUCTION

Commercial banks play a crucial role in the economic development of nations, acting as catalysts for growth by fostering saving habits and mobilizing funds from households and businesses across wide geographical regions (Ayadi et al., 2015; Goodhart, 2004). These funds are directed towards productive agricultural, industry, and trade endeavours, driving economic expansion. Challenges within the banking system can significantly impact a nation's economic health and stability. A thorough evaluation of banks' performance is essential to maintain a robust financial system and promote efficiency within the economy (Gupta, 2014). Understanding these dynamics is crucial for stakeholders like central banks, governments, and financial authorities, as it aids in formulating policies to enhance the financial performance of the banking sector, thus contributing to overall economic advancement. Key metrics for analysis include profitability, growth, and liquidity, with profitability being particularly important for the smooth functioning of the financial system (Tektas et al., 2005). The profitability and performance of commercial banks are vital indicators not only for individual institutions but also for the overall health and growth of the banking sector. Scholars and practitioners have extensively studied the complex dynamics underlying bank profitability, considering both internal and external factors. Onaolapo and Adegoke (2020) highlights profitability as a central component of performance, intertwined with factors like capital structure and credit risk. Tee (2017) and Belete (2013) discuss internal and external determinants, such as asset-liability management culture and macroeconomic indicators.

Asset-Liability Management is crucial in banking for managing risks associated with assets and liabilities. Authors like Al-Shubiri

(2010), Onaolapo and Adegoke (2020), Tee (2017), Belete (2013), and Shrestha (2016) highlight its importance in achieving financial goals, particularly optimizing net interest income (NII). ALM involves planning, organizing, and controlling assets and liabilities to mitigate risks related to liquidity, interest rates, and market fluctuations. Scholars distinguish between defensive and aggressive ALM approaches, with defensive control focusing on stability and aggressive control aiming to maximize net interest margin. ALM is seen as a dynamic process, requiring adaptation to changing market conditions and integrating risk management beyond interest rate fluctuations. Challenges in ALM implementation include the need for understanding ALM concepts, robust information systems development, and effective decision-making processes led by Asset Liability Committees (ALCOs). Quantifying, assessing, and managing various risk categories are crucial for successful ALM practices.

The influence of ALM on bank profitability has been extensively explored in various countries. Still, the empirical examination of ALM in developing Southeast Asian economies like Vietnam is notably limited, unlike in developed economies. Consequently, research findings from other countries may not readily apply to Vietnam due to disparities in economic structure and policies. Therefore, there is a pressing need to investigate the specific influence of asset liability management on the profitability of commercial banks in Vietnam. In this research, we identify the influence of asset-liability management and assess the degree/mechanism to which these elements influence the banks' profitability in Vietnam.

2. LITERATURE REVIEW

Various studies have examined the influence of ALM on bank profitability across different countries and periods. This literature review aims to compare and contrast the findings of several research studies focusing on ALM and its effects on bank profitability.

Al-Shubiri (2010) investigated the influence of asset liability management and external factors such as market concentration and inflation rate on the profitability of selected commercial banks in Bangladesh. They analyzed data from the financial statements of 14 Jordanian commercial banks listed on the Amman Stock Exchange from 2005 to 2008. Their study revealed a significant relationship between various asset variables (such as loans, bills discounted and purchased, deposits with other banks, and government securities) relative to a bank's average total assets, and liability variables (including fixed/time deposits, saving deposits, current and non-interest bearing liabilities, and other borrowings) with operating income, with statistical significance at the 1% level across all years. Additionally, incorporating non-balance sheet variables, the study found a highly significant relationship between the Herfindahl Index and inflation, also at the 1% level. The Assets and Liabilities Committee (ALCO) emerged as a crucial component within this framework, bearing significant responsibility for formulating general strategy and overseeing the overall function of assets and liabilities management.

Shrestha (2016) study focuses on asset liability management and its influence on the profitability of commercial banks in Nepal. Using correlation, regression, and descriptive analysis, the study examined the relationship between ALM and commercial banks over the period of 2007-2008 to 2013-2014. The research holds relevance for bank management, offering insights to identify competitive advantages and disadvantages compared to competitors and informing policy adjustments towards ALM. Additionally, the study contributes to the existing literature on banks' ALM practices and holds significance for policymakers in evaluating financial sector policies and regulations. The findings of the multiple regression analysis indicate a significant relationship between asset liability management and the financial performance of commercial banks in Nepal, with a correlation coefficient of 0.475. Specifically, asset variables such as loans, advances and bills purchase, fixed assets, and other assets positively influence profitability, while liability variables such as deposits and other liabilities negatively impact. Moreover, the study examines the impact of macroeconomic variables, revealing that both GDP and inflation negatively influence commercial banks' profitability. However, it acknowledges the broader implications of these variables in Nepal's economic development.

Najimi et al. (2022) aimed to assess the influence of asset-liability management and macroeconomic factors on banks' profitability while controlling for various variables. They utilized panel data from 2011 to 2021, focusing on seven domestic commercial banks in Afghanistan. The study examined various asset items, including loans and advances, cash equivalents, investments, property and equipment, and other assets, alongside liability items such as current deposits, saving deposits, fixed deposits, and other liabilities for asset-liability management. Additionally, macroeconomic factors like GDP growth rate and inflation rate were incorporated, with bank age and size as control variables. Profitability was measured using the return on assets (ROA) ratio. The findings supported the central hypothesis to some extent, revealing that the return rate on liabilities varied across different categories, with about half showing a negative impact. Similarly, the return rate on assets also exhibited variations across different asset categories. The null hypothesis regarding macroeconomic factors was accepted, indicating a significantly positive contribution to the ROA ratio. Regarding control variables, bank age did not significantly influence profitability, whereas bank size had a notable positive effect on the ROA ratio. The study underscored the influence of balance sheet items and macroeconomic factors on bank profitability, with over fifty percent of regression coefficients being statistically significant. Interestingly, the analysis suggested that while assets did not significantly affect profitability, more than half of the studied liability categories positively influenced the ROA ratio in the Afghan context. This outcome could be attributed to factors such as uncertainty in future investments, high rates of credit defaults, and legal issues prevailing in the region.

Belete (2013) and Gessesow and Venkateswarlu (2023) study delved into assessing the influence of asset liability management on the profitability of private commercial banks in Ethiopia. Belete's study utilized balanced panel data from eight commercial banks

spanning the period from 2005 to 2010. The empirical findings revealed that the profitability of commercial banks in Ethiopia was positively influenced by asset management, including deposits in other banks, other investments and debit balances, and loans and advances. However, fixed assets had a negative impact on profitability. On the other hand, liability management, including demand deposits, saving and fixed deposits, and other liabilities and credit balances, negatively affected profitability. Additionally, macroeconomic variables such as the real growth rate in GDP and the general rate of inflation were incorporated into the study model. The findings indicated that both variables had a negative effect on commercial banks' profitability. Specifically, the real growth rate in GDP exhibited a significant negative effect, contingent upon prevailing economic conditions. Favorable economic conditions were found to positively impact the demand and supply of commercial banking services, thereby enhancing profitability. Employing a panel data approach, Gessesow and Venkateswarlu (2023) analyzed time series data spanning from 2013 to 2022 from 14 private commercial banks in Ethiopia. Pearson correlation analysis revealed that all types of assets included in the study exhibited a positive correlation with profitability (ROA), while all types of liabilities showed a negative correlation with bank profitability (ROA). Notably loans and advances, deposits in foreign banks, investments in securities, and net fixed assets, positively impacted profitability and exhibited variations across asset categories. Conversely, all types of liabilities, particularly savings deposits, demand deposits, fixed deposits, and other liabilities, negatively affected profitability and varied across liability categories. These findings offer valuable insights to bank management by highlighting assets with the highest return on bank profitability and identifying the most cost-effective sources of funds from liabilities. In conclusion, the study emphasizes the significance of ALM and suggests that enhancing focus on this aspect can contribute to improving bank profitability.

Njogo and Ohiaeri Nomisakin (2014) and Onaolapo and Adegoke (2020) conducted an empirical investigation into the influence of asset liability management on the performance in Nigeria of fourteen listed deposit money banks over a period of 14 years, from 2005 to 2018; and of 15 Nigerian banks from 2008 to 2012; respectively. In contrast to the traditional focus on financial institutions, Njogo and Ohiaeri Nomisakin (2014) study explored the adoption of ALM techniques and processes by corporations beyond the financial sector. The findings of the study revealed that all parameters related to asset and liability management, including Total asset per shareholders fund, Total liability per shareholders fund, and Customer deposit per shareholders fund, had a positive and significant impact on profitability during the study period. This suggests that the ALM practices implemented by Nigerian banks, as guided by regulatory authorities, were effective in enhancing profitability. The study underscores the importance of effective ALM practices not only within the financial sector but also across various corporations. It highlights the significance of regulatory oversight in guiding ALM strategies and ensuring their effectiveness in optimizing profitability. Overall, the findings contribute to a broader understanding of ALM's role in driving financial performance and its applicability beyond traditional financial institutions. Onaolapo and Adegoke (2020) utilized loan and advance (LOA), non-performing loan (NPL), and borrowing (BTA) as proxies for ALM, while return on asset (ROA) and return on investment (ROI) served as performance indicators. The study established a significant relationship between ALM proxies and performance indicators. Notably, the study found that ROA, NPL, and bank size (BSZ), which are control variables, were statistically significant in examining the impact of asset management on the profitability of deposit money banks in Nigeria. The results indicated that an increase in LOA and BSZ led to a significant increase in ROA, while a continuous increase in NPL drastically reduced ROA. In line with the study's outcomes, it is recommended that every deposit money bank establishes a comprehensive Asset Liability Management policy framework, driven by a dynamic and proactive asset liability management committee (ALCO) constituted by the board. This committee should play a vital role in regularly evaluating the appropriate mix of assets and liabilities to maximize bank profitability, thereby consistently enhancing performance and creating value for shareholders.

Tee (2017) examined seven banks listed on the Ghana Stock Exchange from 2008 to 2012 and revealed that bank profitability is adversely affected by liabilities, while effective asset management positively influences commercial banks' profitability. The logarithm of total bank assets has a significantly positive impact on profitability. Conversely, the logarithm of total liability has a significantly negative effect on profitability. Furthermore, the study incorporated macroeconomic variables such as the real interest rate and the general rate of inflation. While the interest rate showed no significant effect on profitability, the inflation rate had a negative impact on commercial banks' profitability. However, the influence of the inflation rate on profitability was contingent upon the predictive capabilities of bank management. When predictions were accurate and adjustments in interest rates were aligned with inflation expectations, profitability could be enhanced. Consequently, correct predictions led to a positive effect on bank profitability.

3. DATA AND EMPIRICAL METHODOLOGY

3.1. Data

To explore how asset liability management influences banks' profitability, incorporating both bank-specific indicators and macroeconomic determinants, we propose the following general research model for Vietnamese banks:

$$\text{Profitability}_{it} = \alpha_{it} + \beta_1 \text{ Bank-specific}_{i,t} + \beta_2 \text{ Macro-level}_{i,t} + \varepsilon_{it}$$

In where:

- $\text{Profitability}_{it}$ is the bank profitability of bank i at time t, which is proxied by return on assets (ROA);
- $\text{Bank-specific}_{i,t}$ denotes the bank's features indicators of bank i at time t, which includes in the research the following variables:
  - L (The 2-year average of Loans advances and finance leases to customers to Total Assets, %),
  - IS (The 2-year average of Investment securities to Total Assets, %),
  - DC (The 2-year average of Deposits and borrowings from other credit institutions to Total Assets, %),

  - D (The 2-year average of Deposits from customers to Total Assets, %),
  - TAg (The year-on-year growth rate of Total Assets, %)
- Macro-level$_{i,t}$ represents for macroeconomic variables is GDPg (GDP growth annual %) in Vietnam in year t;
- ε_{it} is the error term and αit is a constant term

The research focuses on a cohort of 18 Vietnamese commercial banks listed on the Ho Chi Minh Stock Exchange (HOSE) as of December 2023. Annual data from 2013 to 2023 was utilized and sourced directly from the HOSE. Specifically, banks were selected based on the availability of their annual reports and accounts within the HOSE archives for the period mentioned above, ensuring adherence to Vietnamese accounting standards. This timeframe was chosen due to significant sector-wide reforms, including recapitalization, consolidation, implementation of cashless policies, and enhancements in corporate governance practices.

Table 1 shows the variables used in the research model and the research hypothesizes. It is hypothesized that bank profitability and asset management have a positive and significant relationship, while a negative and significant relationship is anticipated between bank profitability and liability management. A wealth of scholarly literature underpins this hypothesis. Al-Shubiri (2010) laid the groundwork by highlighting the importance of robust financial capabilities in mitigating risks and enhancing profitability within the banking sector. Furthermore, Belete (2013) provided insights into the intricate relationship between revenue generation from assets and liabilities and the effect on overall bank profitability. Support for the proposed hypotheses can be found in a multitude of studies. Researchers such as Gessesow and Venkateswarlu (2023) corroborated that effective asset management strategies contribute positively to bank profitability, while Tee (2017) emphasized the negative influence of inefficient liability management on profitability. However, dissenting views also exist within the academic discourse. Loans and advances (L) and investments in securities (IS) are two crucial variables representing the asset side of a bank's balance sheet. These variables play significant roles in influencing the profitability and overall financial performance of banks. Loans and advances (L) refer to the amount of money lent out by the bank to customers, including finance leases, relative to the total assets of the bank, expressed as a percentage. This variable reflects the extent to which the bank is involved in lending activities. Investments in securities (IS) represent the amount of funds invested by the bank in various financial instruments, such as bonds, equities, and other marketable securities, relative to total assets, expressed as a percentage. This variable reflects the bank's investment strategy and its allocation of resources into different financial markets. As emphasized by Najimi et al. (2022), loans and advances are essential components of a bank's asset portfolio, representing economic resources utilized by the bank to generate revenue, which can include various types of financing, such as running finance, SME loans, term loans, And investments in securities are significant components of a bank's asset portfolio, providing opportunities for earning returns through interest income, dividends, and capital gains, which can offer diversification benefits and liquidity management opportunities for the bank. The theoretical proposition highlighted by Gessesow and Venkateswarlu (2023) suggests that earning assets, such as loans and investments in securities, typically yield positive returns, albeit varying across different asset types. Tee (2017) further supports this notion by asserting that the rate of return on earning assets is positive and varies across assets. Therefore, effective utilization and management of assets, including loans and advances and investments in securities, are essential for enhancing bank profitability. Belete (2013) reinforces the importance of asset management by explaining that revenue generated from assets, including interest income and service fees derived from

Table 1: Variables in the model

Variables	Description and Measurement	Hypothesized relationship with profitability	Results relationship with profitability	Source
Dependent variables: Bank profitability				
ROA	Return on assets (%)			Najimi et al. (2022), Gessesow and Venkateswarlu (2023), Onaolapo and Adegoke (2020), Shrestha (2016)
Bank-specific variables				
L	The 2-year average of Loans advances and finance leases to customers to Total Assets (%)	+	+	Najimi et al. (2022), Gessesow and Venkateswarlu (2023), Tee (2017), Belete (2013)
IS	The 2-year average of Investment securities to Total Assets (%)	+	+	
DC	The 2-year average of Deposits and borrowings from other credit institutions to Total Assets (%)	−	−	
D	The 2-year average of Deposits from customers to Total Assets (%)	−	−	
TAg	The year-on-year growth rate of Total Assets (%)	+	−	Najimi et al. (2022), Shrestha (2016)
Macroeconomic variables				
GDPg	Annual growth rate of gross domestic product (%)	+	+	Al-Shubiri (2010), Najimi et al. (2022), Belete (2013)

loans and investments, significantly contributes to a bank's net operating income. Thus, effective asset management strategies, such as optimizing asset composition, monitoring asset quality, and maximizing returns, are crucial for improving bank profitability.

Deposits and borrowings from other credit institutions (DC) and deposits from customers (D) are two essential variables representing the liability side of a bank's balance sheet. These variables play significant roles in funding the bank's operations and activities, but they also entail costs and management considerations. Deposits and borrowings from other credit institutions (DC) refer to the funds obtained by the bank from other financial institutions, such as interbank borrowings or loans from central banks, relative to total assets, expressed as a percentage. This variable reflects the extent to which the bank relies on external sources of funding to support its operations and lending activities. As proposed by Gessesow and Venkateswarlu (2023), liabilities typically entail negative returns, varying across different liability types. Therefore, effective management of liabilities, including deposits and borrowings from other credit institutions, is crucial for minimizing funding costs and optimizing the bank's capital structure. Deposits from customers (D) represent the funds deposited by customers into their accounts with the bank, relative to total assets, expressed as a percentage. This variable reflects the bank's ability to attract and retain deposits from retail and corporate clients, which constitute a primary source of funding for the bank's lending and investment activities. As highlighted by Najimi et al. (2022), various components of customer deposits, such as current deposits, savings deposits, and fixed deposits, play significant roles as funding sources for banks. Managing customer deposits effectively involves offering competitive interest rates, providing convenient banking services, and maintaining strong customer relationships. Theoretical propositions by Tee (2017) and Belete (2013) suggest that the cost of liabilities is negative and varies across different liability types. Therefore, efficient liability management is essential for minimizing interest expenses and other costs associated with funding sources, as discussed by Tee (2017). Belete (2013) further explains that liabilities contribute to the costs incurred by banks, including interest expenses on deposits and administrative expenses, which can influence net operating income negatively. Thus, effective liability management strategies, such as optimizing funding sources and minimizing costs, are critical for improving bank profitability.

In understanding the macroeconomic variables that influence bank profitability, it is essential to consider GDP growth annual (GDPg) as a key determinant. The relationship between GDP growth annual and bank profitability has been a subject of extensive research, reflecting diverse perspectives and findings across various studies. Al-Shubiri (2010) emphasize the importance of incorporating macroeconomic conditions, including GDP growth annual, when analyzing bank profitability. They argue that neglecting such factors could lead to biased regression results and unreliable coefficients. Furthermore, Najimi et al. (2022) specifically highlight GDP growth annual rate as a significant macroeconomic indicator reflecting total economic activity. They propose a hypothesis, suggesting a positive relationship between GDP growth annual rate and bank profitability. This hypothesis underscores the potential for economic growth to stimulate demand for financial products and services, thereby enhancing bank profitability during periods of economic expansion. Belete (2013) emphasizes the positive effects of rapid economic growth on bank profitability. Moreover, Dao and Nguyen (2020) delve into the external determinants of bank profitability, particularly focusing on the business cycle. They highlight the robust influence of cyclical output on banking sector performance, noting asymmetry effects that may occur during different phases of the business cycle. In conclusion, the literature emphasizes the complex interplay between annual GDP growth annual and bank profitability, with many studies as Al-Shubiri (2010), Najimi et al. (2022), Belete (2013), and Dao and Nguyen (2020); showcasing a positive impact on banks' financial performance. Therefore, it is anticipated that GDP growth will exert a similar effect on bank profitability in the context of this research.

In examining the hypothesis development concerning the year-on-year growth rate of Total Assets (TAg), several studies provide valuable insights into this variable's significance and its potential implications for bank profitability. Najimi et al. (2022) underscore the importance of considering the growth rate of Total Assets (TAg) in the context of bank profitability. The authors emphasize the need to analyze how changes in total assets over time may influence a bank's financial performance. They argue that understanding the dynamics of total assets is crucial for evaluating the overall health and trajectory of a bank's operations. Furthermore, Dao and Nguyen (2020) provide additional insights into the relationship between total assets and bank profitability, albeit indirectly. Their study on the determinants of profitability in commercial banks in Vietnam, Malaysia, and Thailand sheds light on factors that influence banks' financial performance, including variations in total assets over time. While Dao and Nguyen (2020) may not directly investigate the year-on-year growth rate of Total Assets (TAg), their findings likely offer valuable context for understanding how changes in total assets may affect banks' profitability in different banking environments. Moreover, Ngoc Nguyen (2019) provides relevant insights into the implications of asset growth for bank risk and performance. Although not explicitly focusing on total assets growth, Ngoc Nguyen's study on revenue diversification, risk, and bank performance offers valuable perspectives on how rapid asset growth can influence banks' risk profiles and overall financial health. By examining the relationship between asset growth and risk management practices, Ngoc Nguyen's findings indirectly contribute to understanding the potential implications of total assets growth for bank profitability. In summary, while specific studies directly addressing the year-on-year growth rate of Total Assets (TAg) may be limited, insights from Najimi et al. (2022), Dao and Nguyen (2020), and Ngoc Nguyen (2019) collectively provide valuable context for understanding the significance of total assets growth in the context of bank profitability and performance. These studies highlight the importance of considering asset growth dynamics in analyzing banks' financial health and underscore the need for further research to explore the nuanced relationships between total assets growth in the banking sector.

3.2. Descriptive Statistics

The dataset encompasses both cross-sectional and serial data, compiled as a panel dataset derived from 18 Vietnamese

commercial banks listed on the HOSE, spanning the period from 2013 to 2023, comprising a total of 198 observations. A statistical summary is provided, detailing the count, mean, standard deviation, minimum, and maximum values for each independent variable and the dependent variable. The summary statistics for all factors considered in the study are presented in Table 3.

The mean return on assets (ROA) for the selected banks from 2013 to 2022 is calculated at 1.17%, indicating a positive return on assets across the sampled banks. ROA ranges from a minimum of 0.03% to a maximum of 3.58%, illustrating considerable variability in profitability among the banks over the study period.

There is notable variance in the liabilities of the selected banks, as evidenced by their standard deviation values. Liabilities comprise Deposits and borrowings from other credit institutions (DC) and Deposits from customers (D), with D exhibiting a higher mean value than DC. Specifically, D and DC constitute an average of 14.13% and 62.42% of Total assets (TA), respectively. This suggests a predominant reliance on customer deposits as a funding source for the banks' assets, aligning with the conventional role of commercial banks as intermediaries between depositors and borrowers. Notably, deposits from customers exhibit the highest deviation from its mean at 85.14% of TA, while DC shows the lowest deviation at 0.99% of TA.

Conversely, the mean value of Loans advances and finance leases to customers (L) constitutes the highest proportion among assets, averaging 55.25% of total assets held by Vietnamese commercial banks. This underscores the core function of banks in Vietnam, emphasizing lending activities to customers. Additionally, the spread and standard deviation (10.34%) of the Loans advances and finance leases to customers portfolio indicate notable variability compared to other asset variables studied. Similarly, the mean value of Investment securities (IS) stands at 16.5% with a standard deviation of 7.03% of TA, suggesting a relatively smaller allocation of funds to investments compared to other asset types. The variability of L, with a maximum value of 75.74% and a minimum of 23.78% of TA, further accentuates this observation.

In terms of macroeconomic factors, the mean value of GDP annual growth (GDPg) is calculated at 2.86% with a standard deviation of 1.78%, indicating an average GDP growth rate of 2.86% during the study period in Vietnam. Regarding the control variables, the mean value of Total asset growth (TAg) is recorded at 15.48%, indicating substantial asset growth. The maximum value of TAg suggests that one Vietnam-listed bank experienced a remarkable 60.43% total asset growth within the banking sector.

We also calculate pairwise Pearson's correlation matrix to investigate the potential multicollinearity concerns in Table 2. We observe that the independent variables are only mildly correlated, with the highest correlation being between DC and IS at −0.6018. In addition, The Variance Inflation Factor (VIF) test was conducted to assess multicollinearity among the variables. The mean VIF value across all variables is calculated as 3.33, with all VIF value smaller than threshold of 10 Thus, it is less likely to cause multicollinearity problems when including them in our estimations.

Table 2: Descriptive statistics

Variable	Obs	Mean	Standard deviation.	Min	Max
ROA	198	0.0116657	0.0075899	0.0003	0.0358
L	198	0.5525193	0.1033569	0.2378244	0.7574429
IS	198	0.1650148	0.0702977	0.0432119	0.4395126
DC	198	0.1413088	0.0834226	0.009988	0.4227311
D	198	0.6242196	0.1083553	0.3492269	0.8514227
GDPg	198	0.0285909	0.0178276	−0.017	0.0505
TAg	198	0.1548445	0.1156072	−0.2249867	0.6042757

Table 3: The pooled OLS, fixed and random effect regression model

Model	[OLS]	[REM]	[FEM]
	ROA	ROA	ROA
L	0.0183*	0.0206**	0.0187*
	[2.21]	[2.75]	[2.51]
IS	0.00709	−0.0292**	−0.0431**
	[0.69]	[−2.82]	[−4.01]
DC	−0.0615**	−0.0489**	−0.0478**
	[−5.57]	[−4.88]	[−4.79]
D	−0.0742**	−0.0679**	−0.0627**
	[−9.22]	[−9.32]	[−8.56]
GDPg	0.0419*	0.0172	0.0123
	[1.73]	[0.99]	[0.75]
TAg	−0.00611	−0.0122**	−0.0137**
	[−1.23]	[−3.01]	[−3.46]
_cons	0.0552**	0.0558**	0.0561**
	[5.16]	[5.95]	[6.11]
N	198	198	198
R-sq	0.438		0.629
t statistics in brackets			

*P<0.1, *P<0.05, **P<0.01

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. The Pooled OLS, Fixed and Random Effect Model

Table 3 present the results regarding the influence of ALM, as measured by Loans advances and finance leases to customers (L), Investment securities (IS), Deposits and borrowings from other credit institutions (DC), Deposits from customers (D), Total asset growth (TAg) and GDP annual growth (GDPg) on Return on asset (ROA) of Vietnam commercial banks. These results indicate a discernible linear relationship between bank-specific and macroeconomic variables and ROA.

The findings from Table 3 based on the pooled Ordinary Least Squares effect model, that L, IS, and GDPg positively impact the ROA of selected banks by 1.8%, 0.7%, and 4.2%, respectively. Conversely, DC, D, and TAg exhibit a negative relationship with ROA, leading to a decrease in profitability for deposit money banks by 6.1%, 7.4%, and 0.6%, respectively. In the random effect model outlined in Table 6, it is evident that L and GDPg positively influence ROA by 2% and 1.7%, respectively, while IS, DC, D, and TAg negatively affect ROA, resulting in a reduction of profitability for deposit money banks by 2.9%, 4.9%, 6.8%, and 1.2%, respectively. Table 6 presents the findings from the

fixed effect model, revealing that L and GDPg contribute to an increase in ROA by 1.9% and 1.2%, respectively. Conversely, IS, DC, D, and TAg negatively impact ROA, leading to a decrease in profitability for deposit money banks by 4.3%, 4.8%, 6.3%, and 1.4%, respectively. Notably, the fixed effect model is deemed superior to the OLS model.

Furthermore, nearly all probability values below 0.05 indicate statistically significant estimated parameters for the pooled, fixed, and random effect models in determining the profitability of selected banks in Vietnam. However, probability values of 0.085, 0.32, and 0.457 exceeding 0.05 reveal that the estimated GDP annual growth (GDPg) parameter in the pooled, fixed, and random effect models is statistically insignificant in determining ROA. Overall, the probability values of all F-statistics being <0.05 indicate that the pooled, fixed, and random effect panel models are statistically significant, valid, reliable, appropriate, and acceptable for determining the influence of ALM on the profitability of selected banks in Vietnam

4.2. Heteroskedasticity Test

The Breusch-Pagan/Cook-Weisberg test was employed to assess heteroskedasticity, with weighted regression utilized for testing purposes. The null hypothesis posits the presence of constant variance (homoscedasticity), while the alternative hypothesis suggests evidence of heteroskedasticity in the Random Effects Model (REM) regression models. Table 4 illustrates that the P-value is recorded at 0.0000, which is below the 5% significance level ($P < 0.05$). This indicates the presence of heteroskedasticity in the REM models.

An LM (Lagrange Multiplier) test was conducted to aid in the decision between a random effects regression and a simple OLS regression. The null hypothesis was rejected, indicating that the REM is more appropriate than the OLS model in this scenario.

4.3. Model Specification Test

The Hausman test is carried out to compare and evaluate the selection between REM and FEM for a better fit for the data. Table 5 shows the Hausman test analysis. A P-value with a 0.0000 value implies that the alternative hypothesis is accepted and it implies that the random effect model is not appropriate compared to the fixed effect model for the examination of panel data using regression.

4.4. The Generalized Least Squares (GLS) Model

After determining that the fixed effect model is suitable for the examination of panel data using regression, we proceeded to test the model. To ascertain whether heteroskedasticity exists in the variance of regression coefficients, we conducted a Wald test. This test is performed by comparing the original regression model with a more flexible model, allowing for different regression coefficients across data groups. From the results of Table 6. Wald test, with Prob > $\chi^2 = 0.0000$, which is less than the significance level of 5% ($\alpha = 0.05$), we reject the null hypothesis (H_0) and conclude that the fixed effects model (FEM) does not exhibit heteroscedasticity.

To identify autocorrelation within the regression model, we conducted a Wooldridge test. This test enables us to determine whether autocorrelation exists within the model's residuals, thereby informing our decision on the appropriate regression estimation method. From the results of Table 7. Wooldridge test, with Prob > Chi-square = 0.0003, which is less than the significance level of 5% ($\alpha = 0.05$), we reject the null hypothesis (H_0) and conclude that the FEM exhibits autocorrelation.

To ensure unbiased and efficient estimation results, we employed generalized least squares (GLS) estimation to address the issue of autocorrelation in the selected model (FEM) as detected by the Wooldridge test. GLS allows us to adjust the regression estimates to accommodate autocorrelation within the data, providing more accurate and reliable regression results. The GLS result serves as the final analytical outcome in the study as this model has been tested and rectified for the deficiencies of the FEM.

Regarding the significance level (P-value) of the independent variables, if any variables have regression coefficients <0.05, then those variables are statistically significant and have an impact on

Table 4: Breusch and Pagan Lagrangian multiplier test for random effects

ROA[Code, t]=Xb+u[Code] + e[Code, t]			
Estimated results:			
		Var	SD=SQRT (Var)
	ROA	0.0000576	0.0075899
	e	0.0000149	0.0038579
	u	0.0000134	0.0036547
Test: Var (u)=0			
	Chi-square (01)=162.26		
	Prob>Chi-square=0.0000		

Table 5: Hausman test

Coefficients	(b) FEM	(B) REM	(b-B) Difference	sqrt (diag (V_b-V_B)) Standard error
L	0.0186942	0.0205654	−0.0018711	
IS	−0.0431458	−0.0291908	−0.013955	0.0029091
DC	−0.0477506	−0.0488794	0.0011287	
D	−0.0627331	−0.0679096	0.0051765	0.0007718
GDPg	0.0123471	0.0171681	−0.004821	
TAg	−0.0137161	−0.012188	−0.001528	

b=Consistent under H0 and Ha
B=Inconsistent under Ha, efficient under H0
Test of H0: Difference in coefficients not systematic
Chi-square (6)=(b-B)'[(V_b-V_B)^(−1)](b-B)=129.75
Prob>Chi-square=0.0000
(V_b-V_B is not positive definite)

Table 6: Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0: sigma (i)^2=sigma^2 for all i
Chi-square (18)=171.30
Prob>Chi-square=0.0000

Table 7: Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation
F (1, 17)=20.638
Prob>F = 0.0003

Table 8: Cross-sectional time-series FGLS regression

Coefficients: generalized least squares			
Panels: homoskedastic			
Correlation: panel-specific AR (1)			
Estimated covariances	1	Number of obs	198
Estimated autocorrelations	18	Number of groups	18
Estimated coefficients	7	Time periods	11
		Wald Chi-square (6)	343.09
		Prob>Chi-square	0.0000

ROA	Coef.	Standard error	z	P>z	[95% confidence interval]	
L	0.0375177	0.0067724	5.54	0.000	0.0242441	0.0507913
IS	0.0148828	0.0084737	1.76	0.079	−0.0017253	0.031491
DC	−0.0407472	0.0083613	−4.87	0.000	−0.057135	−0.0243595
D	−0.0708774	0.0051404	−13.79	0.000	−0.0809523	−0.0608025
GDPg	0.008548	0.0112194	0.76	0.446	−0.0134417	0.0305377
TAg	−0.0089739	0.0033394	−2.69	0.007	−0.0155189	−0.0024288
_cons	0.039632	0.0081996	4.83	0.000	0.0235611	0.0557029

the model. Conversely, variables with $P > 0.05$ are not statistically significant and do not affect the model. Regarding the correlation direction of the independent variables that are significant in the model (variables that are not significant in the model do not need to be considered), the study examines whether the correlation aligns with the expected theoretical hypothesis. If the correlation direction contradicts the initial theoretical expectation, the study will consult additional literature sources to support the variable's contrary correlation and provide a rational explanation. If it cannot be explained, the study will reconsider and reprocess the data to improve the results. Regarding the regression coefficient (Coef), if the absolute value of the Coef for any variable is greater, then it is concluded that the variable has a stronger influence.

Table 8 illustrates the influence of controlling variables, including bank-specific indicators and macro indicators, on bank profitability, as measured by return on assets (ROA). The computed coefficients exhibit positivity, and the P-values are statistically significant at the 5% level, indicating a significant relationship. Specifically, Loans advances and finance leases to customers (L) ($P = 0.000 < 0.05$) demonstrates a favorable association with bank profitability metrics. In other words, loans and advances exert a positive influence on bank profitability, with a coefficient suggesting that a one-unit increase in loans and advances leads to a 3.7% increase in the ROA ratio. Although the Investment securities (IS) coefficient suggests an insignificant influence ($P = 0.079 > 0.05$), it still exhibits a positive impact on the ROA ratio. A one percent increase in IS is associated with a 1.5% increase in the ROA ratio. This observation aligns with the findings of Najimi et al. (2022), who assert that loans and advances are integral components of a bank' asset portfolio, representing economic resources utilized to generate revenue. Such resources may include various forms of financing, such as running finance, SME loans, and term loans. This positive relationship is consistent with expectations from findings of prior studies, including those by Gessesow and Venkateswarlu (2023), Tee (2017), and Belete (2013).

Regarding factors exerting a negative influence, the findings from Table 8 highlight that Liabilities comprise Deposits and borrowings from other credit institutions (DC) and Deposits from customers (D) significantly impede the bank's earnings, with a $P = 0.000$ at the 5% level. A one percent increase in DC and D results in a considerable decrease in the profitability ratio of ROA by 4.1% and 7.1%, respectively, marking the most substantial impact among all other independent variables. This negative relationship between deposits and borrowings from other credit institutions, as well as deposits from customers, and bank profitability under ROA is in line with expectations and consistent with previous studies by Gessesow and Venkateswarlu (2023), Najimi et al. (2022), Tee (2017), and Belete (2013). These studies have shown that liabilities contribute to the costs incurred by banks, including interest expenses on deposits and administrative expenses, which can adversely impact net operating income.

In terms of macro indicators, the relationship of GDP annual growth (GDPg) and ROA is positively but insignificant ($P = 0.446 > 0.05$). It helps clear more for research conducted by Al-Shubiri (2010), Najimi et al. (2022), Belete (2013), and Dao and Nguyen (2020) that GDP growth will no exert a effect on bank profitability in the context of this research. In the context of Vietnam, economic growth, particularly within the realm of financial advancements, provides credit institutions such as commercial banks with a conducive environment to flourish (Najimi et al., 2022). It's worth noting that profitability within this sector isn't solely contingent on economic growth. Instead, it's intricately tied to the efficiency of management within the banking system. Given that Vietnam's banking industry is relatively young, higher economic growth can potentially lead to increased expenses outpacing bank income. Unlike their counterparts in developed nations, Vietnamese banks do not exhibit synchronous fluctuations with GDP, a phenomenon explored by Dao and Nguyen (2020) in their examination of external determinants of bank profitability, with a particular focus on the business cycle. The Vietnamese banking sector has yet to reach maturity, with a notable presence of numerous local banks and a discernible trend of burden reduction on major institutions such as BIDV, Vietcombank, VietinBank, and Agribank. Consequently, the trajectory of increasing total assets is anticipated to persist. Even during periods marked by non-performing loans, such as the timeframe spanning from 2011 to 2015, bank profits in Vietnam demonstrated growth rather than decline. Moreover, amidst the economic upheaval precipitated by the COVID-19

pandemic from 2020 to 2022, nearly all banks in the country reported profits. Given the absence of concrete evidence to explain certain phenomena, the study will engage in reassessment and further research to enhance the quality of its findings.

As indicated by ROA, the negative relationship between the year-on-year growth rate of Total Assets (TAg) and bank profitability sheds light on a critical aspect of banking dynamics. When examining the impact of TAg on ROA, the statistically significant P = 0.007 underscores the robustness of this relationship. In essence, this implies that changes in total assets significantly influence a bank's profitability metrics. Furthermore, the specific coefficient of a one percent increase in TAg leading to a 0.9% decrease in the ROA ratio elucidates the magnitude of this impact. Essentially, as a bank's total assets grow over time, there is a corresponding decline in its profitability, as measured by the ROA ratio. This observation underscores the challenges banks may face as they expand their asset base, potentially grappling with diminishing returns or increased operational costs relative to asset growth. Understanding this negative relationship between total assets and bank profitability is crucial for stakeholders in the banking industry, as Najimi et al. (2022), Dao and Nguyen (2020), and Ngoc Nguyen (2019) mentioned. It prompts further exploration into the factors driving this dynamic, such as the efficiency of asset utilization, operational management strategies, and market conditions. By delving deeper into these aspects, banks can formulate more effective strategies to optimize their profitability amidst dynamic shifts in their asset base.

5. CONCLUSION

We provide a comprehensive study on the impacts of asset-liability management on the profitability of banks in Vietnam and to evaluate the mechanisms through which these factors affect financial performance. Utilizing a comprehensive dataset spanning from 2013 to 2023 and comprising 18 Vietnamese commercial banks listed on the HOSE, both cross-sectional and serial data were analyzed. The results reveal several key findings. Bank asset management and annual GDP growth exhibit a positive correlation with profitability, while liability management and the year-on-year growth rate of total assets have a negative influence. Specifically, variables such as loans and advances, and investments in securities on the asset side, and deposits and borrowings from other credit institutions, as well as deposits from customers on the liability side, play significant roles. Notably, lending activities emerge as a crucial driver of financial performance in the Vietnamese banking sector. However, the limited impact of investment securities on profitability warrants further investigation, considering their traditional importance in banking profitability strategies worldwide.

Moreover, the study underscores the adverse effects of certain liabilities on bank profitability, emphasizing the importance of prudent liability management for banks operating in Vietnam. Despite GDP growth being typically associated with economic prosperity and financial sector expansion, its influence on bank profitability in Vietnam appears minimal, suggesting other factors may be more influential. Additionally, the observed negative relationship between the year-on-year growth rate of total assets and bank profitability presents a departure from conventional expectations. In light of these findings, Vietnamese banks are advised to establish a well-structured organizational framework and select asset-liability management models tailored to their characteristics and objectives. They should maintain a strategic focus on lending activities to capitalize on the country's economic growth while also adopting a nuanced approach to optimizing returns from investment securities. Prudent liability management should be prioritized to mitigate risks and enhance profitability, aligning with regulatory requirements and the unique challenges of the Vietnamese banking landscape.

Some limitations of our study provide vendors for future research. First, while we focus on the impacts of asset-liability management on profitability, future research can also explore the roles of asset-liability management on bank efficiency and financial stability. Additionally, further studies could extend our empirical model to other countries using panel data to examine the relationship between asset-liability management on profitability in banks among other countries in a selected region.

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