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# Unveiling the Nexus between Bank-Specific Factors, Macroeconomic Indicators, and Commercial Bank Performance

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*Abstract: This study investigates the performance determinants in Nepalese commercial banks, focusing on both profitability and efficiency scores. Employing a quantitative research approach, panel data from the financial reports of all 28 commercial banks in Nepal from 2008 to 2019 is analyzed. Regression analysis, including fixed and random effect models determined by the Hausman test, is utilized to examine the impact of bank-specific factors and macroeconomic indicators on bank performance. Additionally, data envelopment analysis is employed to measure bank efficiency levels. Findings suggest moderate performance levels with observed improvements in internal management practices and credit policies. While significant impacts of bank-specific factors on performance are identified, macroeconomic indicators show limited influence. Specifically, capitalization and management efficiency positively impact profitability and efficiency, while non-performing assets negatively affect both. These findings provide valuable insights for policymakers and bank management to enhance profitability through prudent regulatory measures.*

**Keywords:** Bank-specific factors, efficiency scores, Nepalese commercial banks, performance determinants, profitability

## I. INTRODUCTION

The financial system constitutes a fundamental pillar of the contemporary economy. A well-structured financial system facilitates the exchange of goods and services by offering payment services, mobilizing savings from diverse sources, and efficiently

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allocating these savings towards productive investments. At the heart of this system lie banks, playing a pivotal role in resource allocation by channeling funds from savers to borrowers and providing specialized financial services that enhance economic efficiency.

The banking sector, both globally and domestically, has been subject to profound transformations influenced by domestic and international factors. Despite the observed trend toward bank disintermediation in several countries, the centrality of banks in financing economic activities remains dominant (Athanasoglou et al., 2008). A robust and profitable banking sector not only absorbs negative shocks but also strengthens the stability of the financial system, garnering keen interest from academic researchers, financial markets, bank supervisors, and management alike (Athanasoglou et al., 2008).

In the context of Nepal, the evolution of the banking sector has been relatively recent. With the establishment of Nepal Bank Limited in 1937, Nepal embarked on its journey towards formal financial services. Subsequent developments, including the establishment of Nepal Rastra Bank in 1956, paved the way for the emergence of various banking institutions, fostering competition and diversity within the sector (Bhetuwal, 2007). Today, Nepal features a multifaceted banking landscape comprising commercial banks, development banks, finance companies, cooperatives, and microfinance institutions.

The rationale for conducting this study stems from the observed stagnation in the performance of Nepalese commercial banks, particularly in indicators such as return on assets (ROA) and net interest margin (NIM), despite the growing number of financial institutions in the country. Additionally, the lack of exploration into the efficiency of these banks, measured through data envelopment analysis (DEA), underscores the need for a comprehensive investigation into the determinants of bank performance. Understanding the factors influencing bank performance is essential for stakeholders to devise strategies that can enhance the efficiency and profitability of the banking sector, thereby contributing to overall economic development in Nepal.

The significance of this study lies in its exploration of the performance of Nepalese commercial banks within a developing economy context. Given the crucial role banks play in economic growth and the financial services industry, understanding their performance determinants holds crucial implications for various stakeholders, including depositors, investors, regulators, and bank management. By analyzing the internal and external factors influencing bank performance and their impact, this research aims to provide valuable insights for informed decision-making amidst the dynamic banking sector and evolving macroeconomic landscape in Nepal.

Against this backdrop, this study aims to examine the performance of Nepalese commercial banks, focusing on profitability and efficiency. By exploring the complex relationships among bank-specific factors, macroeconomic indicators, and the performance of commercial banks, this study aims to make a meaningful contribution to the existing literature on banking within developing economies.

## II. LITERATURE REVIEW

The evolution of banking business models reflects adaptations to economic shifts and regulatory changes. Roengpitya et al. (2017) classify banking models into four main categories: retail-focused, wholesale-focused, trading-focused, and universal models. In Nepal, banks predominantly adhere to retail and wholesale banking models, with a focus on maintaining liquidity through investments in government securities.

Performance in banking is multifaceted, encompassing efficient resource utilization and goal achievement. It involves the integrated use of human, financial, and natural resources to accomplish predetermined objectives (Sun, 2011). Performance evaluation methods vary, including financial ratio analysis, multivariate statistical analysis, data envelopment analysis (DEA), and balanced scorecard approaches.

Financial ratios like ROA and ROE are commonly used to gauge bank performance (Ayadi et al.,1998). However, these measures have limitations, such as sensitivity to company size and accounting practices. Alternative models, such as the Du Pont system and CAMELS ratings, offer comprehensive assessments of banks' financial health and risk management capabilities. Capital adequacy, vital for strengthening financial resilience and ensuring depositor confidence, has undergone evolution through regulatory frameworks such as Basel I, II, and III, continuously refining capital requirements to fortify banking systems against economic shocks. There is another tool for measuring efficiency, especially technical efficiency. This tool employed either the DEA or stochastic frontier analysis (SFA) to measure the relative efficiency of the institutions being evaluated. The balanced scorecard (BSC), introduced by Kaplan and Norton (2004), integrates financial and non-financial measures to align business strategies with performance management systems, although challenges persist in intra- and inter-company comparisons. Other models, such as Meyer and Markiewicz's (1997) critical success factors, and analytical hierarchy process (AHP) adopted by Stankeviciene and Mencaite (2012), offer comprehensive evaluations of bank performance, while rating agencies employ dynamic assessments, integrating various indicators for thorough analyses.

Bank performance is influenced by a myriad of factors, including bank-specific, industry-specific, and macroeconomic variables. Bank-specific factors such as capital adequacy, asset quality, and operational efficiency play crucial roles, alongside macroeconomic indicators like inflation rate and GDP growth. The empirical literature on bank performance predominantly focuses on the relationship between risk, return, and various determinants affecting the profitability and efficiency of banks. Traditionally, bank performance has been measured by assessing both risks and returns (Hempel et al., 1986). Several empirical studies have investigated these relationships across different countries and periods. In US banks, Berger (1995) explored the relationship between ROE and capital asset ratio, finding a positive association between the two variables. Similarly, Angbazo (1997) examined NIM in US banks, identifying management efficiency, default risk, opportunity cost of non-interest bearing reserves, and leverage as positively associated with bank interest margin. Petria et al. (2015) studied EU commercial banks,

revealing the influence of credit and liquidity risk, management efficiency, and economic growth on bank profitability.

Exploring bank profitability across distinct national backgrounds, research conducted in Brazil, Tunisia, and Turkey reveals critical insights into the drivers of financial performance. In the Brazilian context, Afanasieff et al. (2002) found that macroeconomic variables had the most impact on bank interest spread. Similarly, Naceur (2003) highlighted the importance of capital levels and overhead costs in influencing NIM and profitability in Tunisia. Conversely, macroeconomic indicators like inflation and growth rates showed no significant impact on bank profitability in Tunisia. In examining the Turkish banking sector, Atasoy (2007) identified the positive impact of equity ratio and inflation rate on ROA, while Sayilgan and Yildirim (2009) found capital adequacy positively affecting bank profitability in Turkey. The above studies highlight the complex relationship between macroeconomic factors and bank-specific factors in shaping bank profitability across diverse national contexts.

Investigations into bank performance across diverse regions, including Gulf Cooperation Council countries, Malaysia, Pakistan, Bangladesh, and India, reveal a range of factors influencing profitability and efficiency. Alfadli and Rjoub (2020) studied Gulf Cooperation Council countries, showing the impact of efficiency, credit risk, and macroeconomic variables on bank performance. In their study of Malaysian commercial banks, Guru et al. (2002) emphasized efficient expense management as a significant factor explaining high bank profitability, while also noting the positive impact of inflation on bank performance. In their examination of Pakistan's banking sector, Bilal et al. (2013) revealed positive impacts of bank size, NIM, and industry production growth rate on ROA and ROE. Similarly, significant impacts of bank-specific variables and macroeconomic indicators on ROE and ROA in Pakistan were found by Riaz and Mehar (2013). Abdullah et al. (2014) focused on Bangladesh, highlighting the importance of bank size, cost efficiency, and capitalization in determining bank profitability. Al-Homaidi et al. (2018) analyzed Indian commercial banks, highlighting the significant influence of bank-specific factors and macroeconomic indicators on profitability. These comprehensive examinations of bank performance across varied regions underscore the multifaceted nature of factors affecting profitability and efficiency, shedding light on key determinants crucial for understanding the dynamics of banking systems worldwide.

Recent analyses explore the factors affecting bank profitability across different regions, revealing both commonalities and disparities in their results. Al-Jafari et al. (2021) analyzed bank profitability in Saudi Arabia (KSA) from 2009 to 2018. They find that factors like asset utilization ratio, credit risk ratio, and liquidity risk ratio positively impact profitability, while bank size and earning assets ratio have a negative effect. Additionally, inflation and GDP growth negatively affect profitability, emphasizing the importance of asset utilization and government effectiveness. Yuan et al. (2022) studied profitability in Asian banks, focusing on Bangladesh and India. They find that bank size and debt-to-asset ratio positively influence profitability, while deposit-to-asset ratio and loan-to-deposit ratio have a negative impact. Macroeconomic variables like inflation and GDP

growth are significant for ROA. Rumaly (2023) explored ROE factors in Bangladesh, finding that EPS, capital adequacy ratio and bank spread positively influence ROE, while asset size, operating cost-to-loans ratio, total equity-to-debt ratio, and inflation have a negative impact. These three recent studies show both commonalities and differences in bank profitability factors due to regional contexts, methodologies, and regulatory environments. While all consider bank size and macroeconomic variables like inflation and GDP growth, some factors have consistent effects (e.g., inflation), while others vary by region. Methodological differences and diverse focuses on time frames and regions contribute to variations in findings, reflecting the complexity of banking dynamics.

In their examination of Nepalese commercial banks, Pradhan and Shrestha (2016) found that management efficiency strongly affects bank performance, while macroeconomic variables showed no significant impact. Likewise, Shrestha (2016) revealed that asset quality, GDP, and inflation are crucial for determining profitability in terms of ROA, while the capital adequacy ratio primarily influences ROE. Moreover, management efficiency and liquidity emerge as significant factors impacting profitability, particularly about NIM. Overall, this research aids in comprehending the vital factors contributing to the success and stability of Nepalese commercial banks. Similarly, cost per loan assets emerged as a significant factor affecting bank profitability in a study focusing on Nepal by Bhattarai (2018). In their investigation of the determinants of non-performing loans in Nepal, significant relationships with various bank-specific and macroeconomic variables were found by Koju et al. (2018). In the same way, Shrestha (2020) examined the impact of bank-specific factors on the financial performance of Nepalese commercial banks, shedding light on internal operational dynamics and their significance. The study found significant positive effects of managerial efficiency, asset quality, and operational efficiency on financial performance, while credit risk shows a negative impact. The findings underscore the importance of internal operational dynamics in shaping bank performance, providing valuable insights for stakeholders and policymakers. Likewise, Gautam and Gautam (2021) explored how macroeconomic indicators affect the financial performance of Nepalese commercial banks offering insights into broader economic factors shaping bank profitability. Significant influences are found on ROE, particularly from GDP, while ROA shows no significant impact. The study suggests implications for stakeholders to focus on GDP for enhancing bank competitiveness.

The empirical literature presents a rich array of factors influencing bank performance across different countries. While some studies emphasize the importance of bank-specific variables such as management efficiency, capitalization, and size, others underscore the significance of macroeconomic indicators like inflation and GDP growth rate. However, there are notable contradictions and gaps in the literature. For instance, while some studies emphasize the importance of bank-specific variables such as management efficiency, capitalization, and size for bank performance (Berger, 1995; Guru et al., 2002), others underscore the significance of macroeconomic indicators like inflation and GDP growth rate (Afanasieff et al., 2002; Shrestha, 2016; Yuan et al., 2022). While Al-Jafari et al. (2021) found that inflation and GDP growth negatively affect profitability, Naceur (2003)

demonstrated that factors like inflation and growth rates had no significant influence on bank profitability.

The complexity of factors influencing bank performance and the contradictory results of previous studies underscore the need for further research that employs robust methodologies and encompasses a broader scope of variables. This study has attempted to fill this gap by rigorously analyzing a comprehensive dataset spanning over a decade, incorporating both bank-specific and macroeconomic variables. By employing advanced regression models and data envelopment analysis, the study has elucidated the intricate relationships between various determinants and bank performance. The findings shed light on the specific drivers of profitability and efficiency in Nepalese commercial banks, providing valuable insights for both academia and industry practitioners. Moreover, the implications drawn from this research offer actionable recommendations for policymakers and bank management to enhance the financial health and resilience of the banking sector in the region.

## III. METHODOLOGY

This study adopts descriptive and causal research designs integrating both descriptive and inferential statistical analyses. Descriptive research is employed to explain the status of a bank's performance in terms of return on assets (ROA), net interest margin (NIM), and data envelopment analysis (DEA) efficiency score. Causal research is employed to evaluate the effects of bank-specific and macroeconomic variables on bank performance through multiple regression analysis with panel data. Fixed effect and random effect regression models are applied according to the outcomes of the Breusch-Pagan and Hausman tests.

The population comprises 28 commercial banks operating in Nepal during the study period from 2008 to 2019. The study covers the entire population, making it a census study. Most of the previous studies on Nepalese commercial banks excluded the three public banks of Nepal, arguing that it was unreasonable to compare the efficiency of these banks with other banks due to their large asset size and shareholders' equity compared to other banks. However, recent changes in regulations, such as the minimum paid-up capital requirement of Rs. 8 billion for all commercial banks and bank mergers and acquisitions, have led to a substantial increase in asset size and equity for non-public banks as well. Consequently, this study now incorporates public banks also into its analysis. The data were extracted from the annual reports of the sampled banks, the Economic Survey Report of the Ministry of Finance, and the Macroeconomic Indicator of Nepal published by Nepal Rastra Bank. The 12-year study period from 2008 to 2019 is considered sufficient to capture the characteristics of the Nepalese banking industry.

The study employs DEA, financial ratios, and regression models for data analysis. DEA version 2.1 software, Excel, and EViews version 11.0 are used for calculations and statistical analysis. Diagnostic tests including panel unit root tests, multicollinearity tests, and Breusch-Pagan and Hausman tests are conducted to ensure the reliability of regression models.

***Model Specification***

*Variable Selection*

This study employs three proxy variables to measure bank performance: ROA, NIM, and DEA efficiency score. ROA indicates the effectiveness of bank management in generating profits with available assets, while NIM reflects the spread between interest revenue on bank assets and interest expense on liabilities as a proportion of bank assets. DEA efficiency score measures the relative efficiencies of decision-making units (DMUs) within the banking sector.

Bank performance determinants are categorized into bank-specific and macroeconomic variables. Bank-specific variables include capital adequacy, asset quality, management efficiency, liquidity, size, growth opportunities, and credit risk, which serve as proxies for bank characteristics. These variables are measured using ratios such as capital fund to risk-weighted assets, non-performing assets to loans and advances, operating income to total assets, liquid assets to total assets, natural logarithm of total assets, growth in total assets, and loan loss provisions to total loans, respectively. The macroeconomic variables, economic growth and inflation rate, are represented by the real GDP growth rate and annual inflation rate, respectively. These variables capture the broader economic environment within which banks operate.

*Econometric Model*

The study used multiple regression models, where bank performance is measured by their ROA, NIM, and DEA efficiency scores. To examine the impact of bank-specific and macroeconomic variables on bank performance, the following three specifications are estimated under the random effect model and fixed effect model depending on the results of the Hausman test.

$$BP_{it} = \alpha_0 + \beta_i X_{it} + \varepsilon_{it} \quad \text{(i)}$$

$$BP_{it} = \alpha_0 + \beta_i X_{it} + \lambda_i MACRO_t + \varepsilon_{it} \quad \text{(ii)}$$

$$BP_{it} = \alpha_0 + \lambda_i MACRO_t + \varepsilon_{it} \quad \text{(iii)}$$

Where,

Where $BP_{it}$ denotes the performance of bank *i* in year *t*. $X_{it}$ and $MACRO_t$ are the vectors of bank-specific and macroeconomic variables, respectively. $\varepsilon_{it}$ is a disturbance error term, independently and identically distributed as N (0, $\sigma^2$) and $\alpha_0$ corresponds to a bank permanent consequence term, which measures the time-invariant effect exactly for bank *i*; also called Y-intercept.

The above models are used to estimate in three different scenarios. First, only the bank-specific factors are included as the explanatory variables. Second, to examine the combined effect of macroeconomic and bank-specific factors, both bank-specific and macroeconomic variables are included in the model, and finally, only macroeconomic variables are used in the model. These three scenarios are used for each of three dependent variables - ROA, NIM, and DEA, resulting in the following nine models:

$$ROA_{it} = \alpha_0 + \beta_1 CAR_{it} + \beta 2AQit + \beta_3 ME_{it} + \beta_4 LQ_{it} + \beta_5 SZ_{it} + \beta_6 GOP_{it} + \beta_7 CR_{it} \quad (1)$$

$$ROA_{it} = \alpha_0 + \beta_1 CAR_{it} + \beta_2 AQ_{it} + \beta_3 ME_{it} + \beta_4 LQ_{it} + \beta_5 SZ_{it} + \beta_6 GOP_{it} + \beta_7 CR_{it} + \lambda_1 EG_t + \lambda_2 INF_t \quad (2)$$

$$ROA_{it} = \alpha_0 + \lambda_1 EG_t + \lambda_2 INF_t \quad (3)$$

$$NIM_{it} = \alpha_0 + \beta_1 CAR_{it} + \beta_2 AQ_{it} + \beta_3 ME_{it} + \beta_4 LQ_{it} + \beta_5 SZ_{it} + \beta_6 GOP_{it} + \beta_7 CR_{it} \quad (4)$$

$$NIMit = \alpha 0 + \beta 1 CARit + \beta_2 AQ_{it} + \beta_3 ME_i t + \beta_4 LQ_{it} + \beta_5 SZ_{it} + \beta_6 GOP_{it} + \beta_7 CR_{it} + \lambda_1 EG_t + \lambda_2 INF_t \quad (5)$$

$$NIM_{it} = \alpha_0 + \lambda_1 EG_t + \lambda_2 INF_t \quad (6)$$

$$DEA_{it} = \alpha_0 + \beta_1 CAR_{it} + \beta_2 AQ_{it} + \beta_3 ME_{it} + \beta_4 LQ_{it} + \beta_5 SZ_{it} + \beta_6 GOP_{it} + \beta_7 CR_{it} \quad (7)$$

$$DEA_{it} = \alpha_0 + \beta_1 CAR_{it} + \beta_2 AQ_{it} + \beta_3 ME_{it} + \beta_4 LQ_{it} + \beta_5 SZ_{it} + \beta_6 GOP_{it} + \beta 7 CR_{it} + \lambda_1 EG_t + \lambda_2 INF_t \quad (8)$$

$$DEA_{it} = \alpha_0 + \lambda_1 EG_t + \lambda_2 INF_t \quad (9)$$

Where, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$, $\beta_6$, and $\beta_7$ denote the regression coefficient for the bank-specific variables CAR, AQ, ME, LQ, SZ, GOP, and CR respectively. $\lambda_1$ and $\lambda_2$ represent the regression coefficient for the macroeconomic variables EG and INF respectively. In the models, *i* denotes the number of firms and *t* denotes the number of periods.

The decision to employ three distinct scenarios in estimating the econometric models is driven by the aim to comprehensively analyze the influence of both bank-specific and macroeconomic factors on bank performance, as measured by ROA, NIM, and DEA efficiency scores. These scenarios allow for a nuanced examination of how different combinations of variables impact bank performance, thereby providing valuable insights for policymakers, regulators, and financial institutions.

*Scenario 1:* In this scenario, the econometric models exclusively include bank-specific variables as explanatory variables. By isolating the effect of internal bank characteristics on performance, this scenario enables a focused analysis of how factors directly under the control of banks affect their financial outcomes.

*Scenario 2:* In this scenario, both bank-specific and macroeconomic variables are included in the econometric models. This approach allows for an examination of how the interaction between internal bank characteristics and external economic conditions influences bank performance. By incorporating variables such as gross domestic product growth rate (GDP) and inflation rate (INF), this scenario provides a holistic view of the determinants of bank performance, considering both micro-level and macro-level factors.

*Scenario 3:* This scenario involves estimating the econometric models with only macroeconomic variables included as explanatory variables. By excluding bank-specific factors, the focus shifts solely to the impact of broader economic conditions on bank performance. This analysis helps in understanding how changes in the overall economic environment affect the profitability and efficiency of banks, independent of their internal characteristics.

By employing these three scenarios for each of the dependent variables (ROA, NIM, and DEA), a total of nine models are estimated. This comprehensive approach allows for a rigorous investigation of the relative importance of bank-specific and macroeconomic factors in determining bank performance across different dimensions. Furthermore, conducting analyses under both random effect and fixed effect models, depending on the outcomes of the Hausman test, ensures the robustness and reliability of the estimation process, thereby enhancing the validity and credibility of the findings.

*Ethical Considerations, Reliability, and Validity*

The study adheres to ethical standards, ensuring no harm to the reputation and confidentiality of sample banks, avoiding plagiarism, and maintaining integrity in reporting findings. The study ensures reliability through consistency in assessment methods (DEA and ratio analysis) and validity through an extensive literature review, the use of well-tested models, and a comprehensive data set covering all commercial banks in Nepal over 12 years.

*Diagnostic Tests of the Regression Models and Model Specification of Data Envelopment Analysis*

The study conducted diagnostic tests on the regression models to ensure reliability. This included the Augmented Dickey-Fuller test for unit root, ensuring stationarity by using first differences if necessary. Tolerance, VIF, and correlation coefficients were examined to diagnose the presence of multicollinearity, The Breusch-Pagan LM test determined the model choice between random effects and pooled OLS, with the Hausman test used when the latter was rejected, ensuring the appropriate model selection.

The study utilized basic DEA to assess bank efficiency, following the intermediation approach suggested by Berger and Humphrey (1997). It employed an input-oriented DEA model under constant returns to scale (CRS) assumptions, using labor, deposits, and expenses as inputs, and loans, investments, and interest income as outputs. DEA efficiency scores were calculated using linear programming techniques, and DEAP software version 2.1 was employed for analysis.

## IV. RESULTS AND DISCUSSION

### *Results*

*Descriptive Statistics*

Descriptive statistics for variables used in the study, covering performance measurements, bank-specific variables, and macroeconomic variables from 2008 to 2019 are presented in Table 1. The analysis reveals considerable variability in performance measurements such as return on assets (ROA), net interest margin (NIM), and data envelopment analysis (DEA) efficiency. For instance, ROA ranges from -3.43 percent to 18.04 percent, with a mean of 1.56 percent, indicating predominantly high performance

among firms. Similarly, NIM ranges from 0.94 percent to 7.75 percent, with a mean of 3.21 percent, suggesting average performance in terms of NIM. DEA efficiency scores range from 0.7270 to 1.0000, with a mean of 0.9601, indicating high relative efficiency among firms.

The descriptive statistics also highlight significant variations in bank-specific and macroeconomic variables. For instance, the capital adequacy ratio (CAR) has a mean value of 13.10 percent with a standard deviation of 10.00 percent, indicating substantial variability. Similarly, macroeconomic variables such as GDP growth rate and inflation rate exhibit considerable fluctuations, with mean values of 4.97 percent and 8.02 percent, respectively. The small variation between mean and median values across all variables suggests relatively low heterogeneity among sampled banks.

Table 1
Descriptive Statistics

| Variables | Max | Min | Mean | Median | S.D. |
|---|---|---|---|---|---|
| *Panel A: Performance measurements (dependent variables)* | | | | | |
| ROA (%) | 18.04 | -3.43 | 1.56 | 1.51 | 1.32 |
| NIM (%) | 7.75 | 0.94 | 3.21 | 3.13 | 0.91 |
| DEA efficiency (score) | 1.0000 | 0.7270 | 0.9601 | 0.9880 | 0.0573 |
| *Panel B: Bank-specific variables (independent variables)* | | | | | |
| CAR (%) | 77.91 | -48.64 | 13.10 | 12.42 | 10.00 |
| AQ (%) | 31.73 | 0.00 | 2.31 | 1.30 | 3.54 |
| ME (%) | 10.49 | 1.44 | 4.19 | 4.07 | 1.11 |
| LQ (%) | 62.10 | 4.39 | 15.16 | 14.11 | 6.50 |
| SZ (log) | 26.15 | 17.96 | 24.35 | 24.53 | 1.09 |
| GOP (%) | 180.71 | -19.51 | 27.25 | 20.39 | 25.52 |
| CR (%) | 36.18 | 0.00 | 3.18 | 1.97 | 4.07 |
| *Panel C: Macroeconomic variables (independent variables)* | | | | | |
| GDP (%) | 8.22 | 0.59 | 4.97 | 4.80 | 2.03 |
| INF (%) | 12.60 | 4.20 | 8.02 | 8.70 | 2.62 |

*Note.* ROA: Return on asset (%); NIM: Net interest margin (%); DEA: Data envelopment analysis efficiency (score); CAR: Capital adequacy ratio (%); AQ: Asset quality (%); ME: Management efficiency (%); LQ: Liquidity ratio (%); SZ: Size, measured in terms of the natural logarithm of total assets; GOP: Growth opportunities (%); CR: Credit risk (%); EG: Economic growth, measured in term of real gross domestic product, GDP (%); INF: Annual Inflation rate (%).

### *Impact of Bank-Specific and Macroeconomic Variables on Bank Performance*

#### *Regression Diagnostics*

The performance of commercial banks in Nepal is influenced by various factors, including macroeconomic conditions and bank-specific variables. The study has been

conducted to investigate the magnitude of this impact. A panel unit root test was conducted to determine if the data should be differenced to render it stationary. All variables except inflation (INF) are stationary in level form. Therefore, the first differencing was applied to INF to achieve stationarity.

Multicollinearity, a situation where predictors in a regression model are highly correlated, can affect the reliability of statistical inferences. To diagnose multicollinearity, the Variance Inflation Factor (VIF) and Tolerance were examined. When macroeconomic variables (GDP and INF) were included in the model, multicollinearity was observed, with tolerance levels dropping below 0.1 and VIF values exceeding 10. However, excluding macroeconomic variables resulted in acceptable levels of tolerance and VIF, indicating no multicollinearity among the independent variables.

Correlation analysis was also conducted to test for multicollinearity. In general, an absolute correlation coefficient of > 0.7 among two or more predictors indicates the presence of multicollinearity. As exhibited in Table 2, low correlations among explanatory variables indicate no dependency among them, thus indicating a low likelihood of multicollinearity in the regression model used in this study.

Table 2
Correlation Matrix and Multicollinearity Diagnostics

| | **CAR** | **AQ** | **ME** | **LQ** | **SZ** | **GOP** | **CR** |
|---|---|---|---|---|---|---|---|
| CAR | 1.000 | | | | | | |
| AQ | -0.458* | 1.000 | | | | | |
| ME | -0.245* | 0.456* | 1.000 | | | | |
| LQ | 0.288* | -0.001 | -0.177* | 1.000 | | | |
| SZ | -0.416B* | 0.045 | 0.323* | -0.225* | 1.000 | | |
| GOP | 0.256* | -0.154* | -0.460* | 0.187* | -0.380* | 1.000 | |
| CR | -0.433* | 0.701* | 0.473* | 0.010 | 0.074 | -0.133** | 1.000 |

**. Correlation is significant at 0.01 level (t-tailed).*

***. Correlation is significant at the 0.05 level (t-tailed).*

### *Lagrange Multiplier (LM) Test for Random Effects Versus Ordinary Least Squares*

In panel and pool regression settings, it is crucial to test for the existence of cross-sectional and time effects to ensure correct specification and inference. The Breusch-Pagan LM test is commonly used for random effects testing. A significant result indicates the presence of panel effects, necessitating the use of fixed or random effect models. In this study, the p-value of the Breusch-Pagan LM test was found to be less than 0.05, for all the nine models, rejecting the null hypothesis of no significant difference across cross-sectional units, indicating the presence of panel effects (See Tables 4, 5, and 6). Put differently, there is evidence of heteroscedasticity in the models. Thus, the pooled OLS model cannot be used, and the Hausman Test is applied to choose between fixed and random effect models.

Table 3
Impact of Bank-Specific and Macroeconomic Variables on ROA

| | Model 1 (Fixed Effect Model) | | Model 2 (Random Effect Model) | | Model 3 (Fixed Effect Model) | |
|---|---|---|---|---|---|---|
| | **Coef.** | **t-statistic** | **Coef.** | **t-statistic** | **Coef.** | **t-statistic** |
| Constant | -6.188742 | -4.089232* | -5.757733 | -3.490412* | 1.358622 | 7.238329* |
| CAR | 0.013040 | 1.701367 | 0.008169 | 0.999622 | | |
| AQ | -0.065038 | -2.682008* | -0.205029 | -6.412566* | | |
| ME | 0.843578 | 10.50179* | 0.650513 | 8.840426* | | |
| LQ | 0.005774 | 0.604428 | 0.004509 | 0.462282 | | |
| SZ | 0.140861 | 2.395425* | 0.162418 | 2.448168* | | |
| GOP | 0.009538 | 4.092943* | 0.004805 | 1.885210 | | |
| CR | 0.131998 | 6.394598* | 0.226167 | 8.192518* | | |
| GDP | | | 0.012672 | 0.441879 | 0.044171 | 1.202548 |
| D(INF)# | | | 0.014988 | 0.748171 | 0.036586 | 1.414365 |
| Adjusted $R^2$ | 0.580043 | | 0.471496 | | 0.249651 | |
| SEE | 0.853881 | | 0.852721 | | 1.127573 | |
| F-statistic | 14.60886 | | 31.43161 | | 4.522176 | |
| p-value of F-statistic | 0.000000 | | 0.000000 | | 0.000000 | |
| LM Test: (p-value of Breusch-Pagan) | 0.0000 | | 0.0000 | | 0.0000 | |
| Hausman Test (p-value of period random) | 0.0042 | | 0.3359 | | NA## | |

** Significance at a 5 percent level of confidence.*

*Note. #The function D in D(INF) takes the first difference of a series.*

*## Due to an insufficient number of common coefficients, the Hausman test could not be applied to determine whether the fixed effect model fits the data better than the random effect model. Consequently, the fixed effect model was selected for further analysis, as it better fits the data.*

### *Hausman Test for the Models*

The Hausman test helps to choose between fixed and random effect models. In this case, the null hypothesis is that the random effect regression is appropriate. As evidenced in Tables 4, 5, and 6, the p-values of the Hausman test chi-square statistics are less than 0.05 for models 1, 4, and 5, suggesting the use of a fixed effect model for these models. Conversely, the p-values of the Hausman test chi-square statistic are greater than 0.05 for models 2, 7, and 8, indicating the preference for the random effect model for these cases. The Hausman test could not be applied in models 3, 6, and 9 due to an insufficient number of common coefficients. Hence, the fixed effect model is utilized for these models, as it provides a better fit to the estimates compared to the random effect model.

*Results of Model Estimation*

Three specifications are estimated under both fixed and random effect models depending on the Hausman test results. These models examine the impact of bank-specific and macroeconomic variables on bank performance. Each model is run for three dependent variables: ROA, NIM, and DEA. The results indicate the significance and direction of the impact of different variables on bank performance across the models.

Table 3 displays the results of three regression models examining the impact of bank-specific and macroeconomic variables on ROA. The adjusted R2 values in the table indicate that the regression models, adjusted for the number of predictors, provide a reasonable fit to the data, suggesting that the models capture a substantial portion of the underlying relationships. The statistical significance of Models 1, 2, and 3 is evident, with their respective F-statistics showing p-values below the conventional level of 0.05, indicating that each model is statistically significant.

Model 1 reveals that the variables ME, SZ, GOP, and CR are positively and statistically significant at the 5 percent level suggesting that an increase in factors leads to a significant increase in ROA. Additionally, AQ, with a negative coefficient, shows significance at the 5 percent level, indicating that a decrease in AQ is associated with higher ROA.

Macroeconomic variables are included as explanatory variables in Model 2. As shown in Table 3, none of the macroeconomic variables are statistically significant at the 5 percent level. However, the beta coefficients for ME, SZ, and CR are positive and statistically significant, indicating a positive relationship with ROA. Similar to the first model, the beta coefficient for AQ is negative and statistically significant, indicating a negative relationship with the dependent variable ROA.

Positive beta coefficients are observed for GDP and D(INF) in Model 3. However, the beta coefficients for these variables are insignificant at the five percent level. Consequently, macroeconomic variables have no significant influence on the ROA of Nepalese commercial banks.

The results from Table 4 provide insights into the impact of bank-specific and macroeconomic variables on NIM across three regression models. The p-values associated with the F-statistics in the table for Models 4, 5, and 6 are less than the conventional significance level of 0.05, indicating that the independent variables collectively have a significant effect on the dependent variable.

Model 4 reveals that the variables CAR, ME, and CR are statistically significant at the 5 percent level, indicating a strong association with NIM. Specifically, increases in CAR, ME, and CR are correlated with higher NIM. Additionally, AQ is significant at the 5 percent level, implying a negative relationship with NIM; thus, a decrease in AQ is associated with higher NIM.

Two macroeconomic indicators, GDP and D(INF), are included as explanatory variables in Model 5. The ME remains statistically significant at the 5 percent level,

reinforcing its importance in explaining variations in NIM. Similarly, CAR also retains significance at the 5 percent level, indicating its substantial impact on NIM. However, AQ and CR become insignificant in this model, suggesting their limited influence on NIM.

Only macroeconomic variables were regressed on NIM, excluding the bank-specific variables in Model 6. The results reveal that the beta coefficients of both independent variables are positive but statistically insignificant at a five percent level of significance, indicating a very weak positive influence of macroeconomic variables on the NIM of commercial banks.

Table 4
Impact of Bank-Specific and Macroeconomic Variables on NIM

| | **Model 4 (Fixed Effect Model)** | | **Model 5 (Fixed Effect Model)** | | **Model 6 (Fixed Effect Model)** | |
|---|---|---|---|---|---|---|
| | **Coef.** | **t-statistic** | **Coef.** | **t-statistic** | **Coef.** | **t-statistic** |
| Constant | -0.573763 | -2.176025* | -0.365160 | -1.280939 | 3.182741 | 30.30392* |
| CAR | 0.007657 | 5.733975* | 0.008395 | 6.036079* | | |
| AQ | -0.027878 | -6.598496* | 0.000841 | 0.157038 | | |
| ME | 0.819580 | 58.56278* | 0.834428 | 60.42596* | | |
| LQ | -0.002305 | -1.384877 | -0.000665 | -0.392360 | | |
| SZ | 0.012429 | 1.213169 | -0.000117 | -0.010439 | | |
| GOP | -0.000616 | -1.517281 | 0.000058 | 0.139577 | | |
| CR | 0.020305 | 5.646095* | 0.005125 | 1.137282 | | |
| GDP | | | -0.005373 | -1.187522 | 0.013237 | 0.644054 |
| D(INF)# | | | -0.002701 | -0.858400 | 0.002709 | 0.187189 |
| Adjusted $R^2$ | 0.973081 | | 0.978385 | | 0.506525 | |
| SEE | 0.148767 | | 0.132048 | | 0.630938 | |
| F-statistic | 357.1625 | | 387.0018 | | 11.86615 | |
| p-value of F-statistic | 0.000000 | | 0.000000 | | 0.000000 | |
| LM Test: (p-value of Breusch-Pagan) | 0.0000 | | 0.0000 | | 0.0000 | |
| Hausman Test (p-value of period random) | 0.0004 | | 0.0053 | | NA## | |

** Significance at a 5 percent level of confidence.*

*Note. #The function D in D(INF) takes the first difference of a series.*

*##Due to the insufficient number of common coefficients, the Hausman test could not be applied for the test. Consequently, the fixed effect model was selected for further analysis, as it better fits the data.*

For Models 7, 8, and 9 in Table 5, the p-values of the F-statistics are less than 0.05, indicating that each model is statistically significant at conventional significance levels. The findings presented in Table 5 shed light on how bank-specific and macroeconomic variables influence the DEA efficiency score across three regression models.

Table 5
Impact of Bank-Specific and Macroeconomic Variables on DEA Efficiency Score

| | Model 7 (Random Effect Model) | | Model 8 (Random Effect Model) | | Model 9 (Fixed Effect Model) | |
|---|---|---|---|---|---|---|
| | **Coef.** | **t-statistic** | **Coef.** | **t-statistic** | **Coef.** | **t-statistic** |
| Constant | 0.669945 | 11.05817* | 0.719418 | 10.36434* | 0.955365 | 134.7427* |
| CAR | 0.003579 | 11.74799* | 0.003887 | 11.37034* | | |
| AQ | 0.001530 | 1.555640 | 0.002866 | 2.161336* | | |
| ME | 0.009312 | 3.030835* | 0.009191 | 2.843382* | | |
| LQ | -0.002510 | -6.609553* | -0.002887 | -6.995693* | | |
| SZ | 0.010062 | 4.242928* | 0.008183 | 2.970149* | | |
| GOP | -0.000108 | -1.135353 | -0.000116 | -1.112504 | | |
| CR | -0.001027 | -1.224388 | -0.001936 | -1.714472 | | |
| GDP | | | -0.000144 | -0.125290 | 0.001443 | 1.039874 |
| D(INF)# | | | -0.000145 | -0.180592 | -0.000976 | -0.998877 |
| Adjusted $R^2$ | 0.371533 | 0.368276 | | 0.385847 | | |
| SEE | 0.035831 | 0.034413 | | 0.042594 | | |
| F-statistic | 29.29187 | 20.88572 | | 7.650888 | | |
| p-value of F-statistic | 0.000000 | 0.000000 | | 0.000000 | | |
| LM Test: (p-value of Breusch-Pagan) | 0.0000 | 0.0000 | | 0.0000 | | |
| Hausman Test (p-value of period random) | 0.7447 | | 0.9576 | | NA## | |

** Significance at a 5 percent level of confidence.*

*Note. #The function D in D(INF) takes the first difference of a series.*

*## Due to the insufficient number of common coefficients, the Hausman test could not be applied for the test. Consequently, the fixed effect model was selected for further analysis, as it better fits the data.*

CAR, ME, LQ, and SZ in Model 7 are found to be statistically significant at the 5 percent level. Their coefficients indicate that increases in CAR, ME, and SZ are associated with higher efficiency of banks measured in terms of DEA efficiency scores, due to their positive coefficients, while an increase in LQ would lead to a decrease in DEA efficiency scores as it has a negative coefficient. Conversely, AQ, GOP, and CR demonstrate insignificance at the 5 percent level, suggesting their minimal impact on DEA efficiency scores.

In Model 8, CAR, AQ, ME, LQ, and SZ remain statistically significant at the 5 percent level, further emphasizing their importance in explaining variations in DEA efficiency scores. CAR, AQ, ME, and SZ positively influence while LQ negatively influences.

However, similar to Model 7, GOP and CR remain insignificant at the 5 percent level in this model as well, suggesting their limited impact on DEA efficiency scores. Additionally, GDP and D(INF) exhibit insignificant and negative effects on DEA efficiency scores, indicating that macroeconomic variables have a weak influence on bank efficiency as measured by DEA efficiency scores.

Bank-specific factors were excluded from Model 9 to examine the influence of only macroeconomic factors on bank efficiency. The beta coefficients of both factors are statistically insignificant at a five percent level. GDP exhibits a positive beta coefficient, suggesting a weak positive influence, while inflation demonstrates a negative beta coefficient, indicating a weak negative influence on bank efficiency as measured by DEA scores.

To summarize, the variables that consistently demonstrate a significant positive impact across all models and performance measures are ME and AQ. These variables consistently appear as statistically significant predictors across various models and performance measures, indicating their robust positive influence on bank performance, whether assessed by ROA, NIM, or efficiency scores measured by DEA. The variables GDP and D(INF) consistently exhibit an insignificant impact across all models and performance measures.

*Discussion*

The examination of the influence of bank-specific and macroeconomic variables on bank performance draws comparisons with prior research to contextualize and validate the findings. The impact of factors like CAR, AQ, ME, and SZ on performance indicators such as ROA and NIM aligns with previous studies. For instance, the positive association between CAR and ROA echoes the findings of Naceur (2003), who observed profitability linked to higher capitalization levels. Similarly, the negative impact of asset quality on ROA, consistent with the results of Bilal et al. (2013), underscores the importance of managing nonperforming loans effectively. Moreover, the positive influence of ME on ROA resonates with the findings of Riaz and Mehar (2013), emphasizing the role of efficient management practices in enhancing bank performance. Similarly, while the significant positive relationship between bank size and ROA contradicts the findings of Espinoza and Prasad (2010), it aligns with those of Louzis et al. (2012) and Koju et al. (2018), suggesting that larger banks may benefit from economies of scale. In terms of macroeconomic variables, the insignificant impact of GDP growth and inflation on ROA aligns with the conclusions of Bennaceur and Naceur (2008), indicating limited macroeconomic influence on bank profitability. The findings corroborate the results of Gautam and Gautam (2021), who found that GDP does not affect ROA. However, these findings contradict those of Shresth (2016), who concluded that both GDP and inflation are significant factors in determining profitability as measured by ROA.

Moving to NIM, the significant positive effect of CAR and ME underscores the importance of capitalization and efficiency in augmenting interest margins, in line with Athanasoglou et al. (2008) and Shresth (2016). However, the insignificant impact of

macroeconomic variables on NIM contrasts with the findings of some previous studies, highlighting the nuanced relationship between economic indicators and bank performance.

Further exploration of efficiency scores via DEA analysis reveals insights into the determinants of bank efficiency. While CAR, ME, and SZ demonstrate significant positive effects on efficiency, the negative impact of liquidity echoes findings from previous studies such as those by Louzis et al. (2012). Interestingly, the inclusion of macroeconomic variables in regression models does not substantially alter the results, suggesting that bank-specific factors exert a more significant influence on performance compared to macroeconomic conditions. This finding aligns with Naceur (2003), who emphasized the limited impact of macroeconomic indicators on bank profitability.

## V. CONCLUSION AND IMPLICATIONS

This study explores the performance of Nepalese commercial banks, focusing on profitability and efficiency as essential indicators. Nepalese banks operate at moderate performance levels, with discernible improvements in internal management practices and credit policies. The robust capitalization of Nepalese banks, coupled with their adeptness in managing unforeseen losses, instills confidence among investors and enhances overall bank credibility. Furthermore, favorable macroeconomic conditions, characterized by positive GDP growth and negative inflation rates, provide an enabling environment for bank operations.

Various bank-specific factors play crucial roles in shaping the profitability and efficiency of Nepalese banks. Factors such as capital base, management efficiency, size, growth opportunity, credit risk, and asset quality emerge as key determinants of bank performance. Specifically, an augmentation in capital base, management efficiency, size, growth opportunity, and credit risk positively impacts profitability as measured by return on assets. Similarly, an improvement in capital base, management efficiency, and credit risk positively influences performance measured by net interest margin, while an escalation in non-performing assets diminishes both return on assets and net interest margin. The analysis reveals insights into the determinants of bank efficiency as measured by DEA scores, concluding that factors such as capital adequacy ratio, asset quality, management efficiency, and size have significant impacts on bank efficiency. Larger banks benefit from economies of scale, while effective management practices positively influence bank efficiency.

The implications of this study extend to policymakers, bank management, and researchers alike. For policymakers, a focus on enhancing profitability through internal determinants, alongside prudent regulatory measures, is recommended. Bank management should prioritize bank-specific factors over macroeconomic variables to drive performance improvements effectively. Additionally, diversifying income streams, particularly through non-fund-based activities, can increase profitability.

Future studies could adopt comparative analyses across countries to identify commonalities and differences in determinants of bank performance. Moreover,

integrating qualitative methods could provide deeper insights into the mechanisms underlying these relationships. Overall, addressing these complexities requires interdisciplinary approaches and collaboration between researchers, policymakers, and industry practitioners.

The exclusion of qualitative insights from key stakeholders like bank managers and customers in this study might restrict a comprehensive understanding of bank efficiency determinants. Additionally, the study is also limited by its omission of an analysis of regulatory measures such as financial consolidation, which could have potentially impacted the banking business.

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## *Conflict of Interest*

The author declared having no conflict of interest in the research work.

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