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Operational Optimization and Cost Efficiency in Nepalese Banks

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Abstract

The purpose of this study was to explore the key factors influencing cost efficiency in Nepalese commercial banks. By examining the impact of endogenous variables including bank size (S), return on assets (ROA), capital adequacy ratio (CAR), credit risk (CR), and net interest margin (NIM), this study explores the complex relationship between these variables and cost efficiency. Utilizing a balanced panel dataset spanning a decade from 2011/12 to 2020/21, the study employed descriptive and inferential analyses, along with econometric models such as pooled OLS (ordinary least squares), fixed effects regressions, and random effects regression techniques. Additionally, various statistical tests, including the variance inflation factor test, Hausman specification test, and the Breusch-Pagan test for homoscedasticity, were conducted to ensure the robustness of the models. The results found that return on assets (ROA) and capital adequacy ratio (CAR) exert a positive influence on cost efficiency, while the net interest margin (NIM) exhibits a negative impact. However, no significant relationship was found between bank size, credit risk, and cost efficiency. These results emphasize the importance for banks to prioritize the enhancement of their return on assets (ROA) and capital adequacy ratio (CAR) while maintaining an optimal net interest margin (NIM). The study offers valuable insights for bank management and policymakers, contributing to an improved understanding of cost efficiency in Nepal's commercial banks. By providing evidence-based recommendations, this research opens the path for the formation of strategies aimed at optimizing operational undertakings and fostering overall cost-efficiency within Nepalese banks.

Keywords: Panel Data, Capital Adequacy, Credit Risk, Net Interest Margin, Return on Assets

1. Introduction

The banking sector is an integral part of the financial system, playing a significant role in the development of an economy (Akrani, 2011). With their primary function of mobilizing deposits and providing loans and advances to various sectors, such as agriculture, industry, and business, private and public banks compete each other in the free and open market economy (Bhattarai, 2015; Bhandari et al., 2021). However, for the banking sector to effectively contribute to economic development, it is crucial to ensure consistency and efficiency (Akrani, 2011).

Cost efficiency is a fundamental concept that focuses on saving money by improving processes and products (Miller, 2022). In the banking context, cost efficiency is determined by comparing total operating costs to total income, where a larger ratio indicates lower cost efficiency and vice versa. Cost efficiency is crucial for banks as it directly impacts their profitability, success, and sustainability (Miller, 2022). Furthermore, it enables banks to optimize their capabilities, generate more revenue, and provide enhanced value to customers (Bergret et al., 1993).

In Nepal, where there are 22 commercial banks as of the end of 2022, cost efficiency becomes even more critical as these banks offer a range of services such as loans, savings accounts, and certificates of deposit (Williams, 2022). Achieving cost efficiency is vital not only for the banks themselves but also for facilitating economic growth and supporting various sectors, including agriculture, trade, industry, energy, and services (Bhattarai, 2015; Karki, 2012, 2018). Efficiency measures in the banking sector are viewed as essential tools for improving bank performance and providing bank-specific information to enhance efficiency (Tecles & Tabak, 2010). Efficient banks can provide trustworthy services to consumers at optimal prices, thereby fostering faith, confidence, and reliability in the banking sector and equity market (Zeitun & Benjelloun, 2012; Karki, 2017). In an increasingly competitive banking industry due to deregulation, liberalization, and globalization, cost efficiency becomes a significant challenge for commercial banks to remain competitive (Dahal & Bhaskar, 2020).

Recent studies have highlighted challenges in achieving cost efficiency in the Nepalese banking industry. These include high-ratio problems leading to a lack of cost efficiency (Dahal & Bhaskar, 2020) and a decline in efficiency due to adverse political situations, liquidity crunch, and inefficient management practices (Neupane, 2013). Moreover, deregulation, liberalization, globalization, and change in employee professional dynamics have further intensified competition, necessitating higher levels of efficiency and stability (Dahal & Bhaskar, 2020; Bhattarai et al., 2020). The cost efficiency of Nepalese banks has been a subject of concern, as evidenced by Adhikari's (2021) survey of 27 commercial banks conducted between 2011/12 and 2019/20. Adhikari (2021) revealed a decline in average efficiency from 47.3% to 39.42% in 2015/16, followed by a slight increase to 40.38% in 2019/20. These results emphasize the inherent instability and predominantly inefficient nature of the efficiency ratio among Nepalese banks. However, by improving their operational efficiency and functioning optimally, banks can unlock their latent capabilities, generate increased revenue, and enhance customer value, ultimately improving efficiency and contributing to the overall economic development of the nation. Given the challenges faced by Nepalese commercial banks, this research proposes to address the subsequent three research questions. 1) What are the most significant factors influencing cost efficiency in Nepalese commercial banks? 2) Is there a significant relationship between various independent variables (S, ROA, CAR, CR, & NIM) and the dependent variable (cost efficiency) of Nepalese commercial banks?, and 3) What is the impact of the various independent variables (S, ROA, CAR, CR, & NIM) on the cost efficiency of Nepalese commercial banks?

With these research questions in focus and given the importance of cost efficiency for profitability, success, and sustainability in the banking sector, the primary objective of this research is to determine the operational factors that have a major influence on cost efficiency in Nepalese commercial banks. Through a comprehensive analysis of the link between these factors and cost efficiency, this research seeks to provide valuable insights for bank management and policymakers into optimizing operational variables that drive cost efficiency in Nepal's banking sector.

2. Literature Review

Several researchers have conducted studies on cost efficiency in banking across various countries, revealing valuable insights into the factors influencing efficiency in different contexts. The profitability and competitiveness of financial institutions are directly impacted by cost efficiency in the banking sector (Berger & Humphrey, 1997). It involves optimizing resource allocation, improving productivity, and adopting efficient management practices to achieve higher output with minimal resource utilization and expenses. Adopting new technologies makes banks more cost-effective, but acceptance is reliant on people's understanding, knowledge, and level of education (Dahal et al. 2020; Maharjan et al. 2022). Cost efficiency is the ratio of overhead expenses to the total net interest revenue and other operating revenue (Amer et al., 2011). A lower ratio indicates that a bank is operating more efficiently. Several studies have examined the determinants of cost efficiency in banking. For instance, Maudos, Pastor, and Perez (2002) explored the cost efficiency of European banks, highlighting the influence of market structure, ownership, and financial liberalization on cost efficiency. In addition, Casu and Thanassoulis (2006) conducted research on central bank branches in the UK, applying frontier efficiency analysis to evaluate their cost performance. They found that this approach can effectively assess cost efficiency in central bank operations. Meanwhile, Sufian and Habibullah (2009) investigated the determinants of bank efficiency in Malaysia, including factors such as bank size, capitalization, and market structure. Their findings shed light on the specific factors that contribute to cost efficiency in a developing economy.

Bank Size: The connection between bank size and cost efficiency has been extensively studied in various banking systems. Gajurel (2010) conducted a study on the factors affecting cost efficiency in Nepalese banks and revealed a positive correlation between bank size and cost efficiency. In Malaysian banks, Ab-Rahim et al. (2012) explored the link between bank size and cost-effectiveness and found conflicting results. Their study revealed the positive effects of population density, government ownership, market concentration, and demand density on cost efficiency. However, the impact of macroeconomic conditions, capitalization, credit risk, and bank size on cost efficiency showed mixed evidence. Similarly, Stanek (2015) conducted a study on Czech commercial banks and did not find a significant influence of bank size on cost efficiency. These contradictory findings suggest the need for more comprehensive research to understand the specific dynamics of the relationship between bank size and cost efficiency in different regions.

H_1: There is a significant relationship between bank size and the cost efficiency of Nepalese commercial banks.

Return on Assets: The relationship between return on assets (ROA) and cost efficiency has been extensively explored in the literature. Nitoi and Spulbar (2015) conducted a study in emerging countries in Central and Eastern Europe and found a positive influence of ROA on cost efficiency. This suggests that banks with higher ROA tend to exhibit higher levels of cost efficiency. Similarly, Elahi and Poswal (2017) examined banks in the United Kingdom and Germany and discovered a significant positive relationship between ROA and cost efficiency. Their findings indicate that banks with higher ROA are more likely to achieve better cost efficiency. In the context of Nigerian commercial banks, Ojeyinka and Akinlo (2021) investigated the factors affecting cost efficiency and found a positive effect of ROA on cost efficiency. These findings highlight the potential importance of ROA as a determinant of cost efficiency in the banking sector. However, it is essential to critically appreciate that these researches were carried out in different contexts, and their findings may not directly apply to the Nepalese banking sector.

H_2: There is a significantly positive relationship between the Return on Assets (ROA) and cost efficiency of Nepalese commercial banks.

Capital Adequacy Ratio: The effect of the capital adequacy ratio (CAR) on cost efficiency in the banking sector has been studied in the past. Ereta et al. (2020) conducted a study in Ethiopian commercial banks and found a positive correlation between CAR and cost efficiency. This suggests that greater levels of capital adequacy can contribute to improved cost efficiency in banks. Similarly, Adhikari (2021) examined Nepalese commercial banks and reported a negative relationship between CAR and cost efficiency. Their findings indicated that higher CAR was associated with lower cost efficiency. Further, Blankson et al. (2022) measured the cost-efficiency of Ghanaian banks and reported a positive impact of capitalization on cost-efficiency. However, it is crucial to note that this study was conducted in the Ghanaian banking sector, which may have different characteristics and regulatory frameworks compared to Nepalese commercial banks. To provide additional reference and validate the earlier findings, it is important to investigate whether CAR has a significantly positive relationship with cost efficiency in Nepalese commercial banks.

H_3: There is a significantly positive relationship between the Capital Adequacy Ratio (CAR) and the cost efficiency of Nepalese commercial banks.

Credit Risk: The causal relation between credit risks and cost-efficiency in Nepalese commercial banks has been the subject of investigation in several studies. Gajurel (2010) analyzed factors affecting cost efficiency in Nepalese commercial banks and found that higher credit risk is associated with lower cost efficiency. The study revealed that government banks exhibited lower cost-efficiency compared to private sector banks (both domestic & foreign), emphasizing the importance of effectively managing credit risk to enhance cost-efficiency in the Nepalese banking industry. Furthermore, Adjei-Frimpong et al. (2014) explored the effectiveness of the Ghanaian banking sector and examined the impact of credit risk, measured by loan loss provision (LLP), on cost efficiency. Utilizing a data envelopment model and static and dynamic panel data analysis, the study demonstrated a negative association between credit risks and cost-efficiency in Ghanaian banks. Specifically, well-capitalized banks exhibited lower cost efficiency, highlighting the significance of managing credit risk to enhance overall efficiency. However, it is crucial to recognize that the influence of credit risks on cost efficiency may vary across different banking systems and timeframes. Hadhek et al. (2018) documented a positive relationship between credit risks and cost-efficiency in Islamic banks, suggesting that the relationship can differ based on the specific characteristics of the banking system. Therefore, it is essential to investigate the relationship between credit risks and cost-efficiency in the context of Nepalese commercial banks, considering the unique characteristics and dynamics of the Nepalese banking sector.

H_4: There is a significantly negative relationship between credit risk and cost efficiency of Nepalese commercial banks.

Net Interest Margin: The impact of net interest margin (NIM) on cost efficiency has been the focus of research in various banking systems. Esho (2001) conducted a study on factors affecting cost efficiency in cooperative financial institutions in Australia and discovered a positive influence of net interest margins on cost efficiency. The study revealed steady progress in cost efficiency over the analyzed period, underscoring the importance of effectively managing net interest margins to enhance the efficiency of cooperative financial institutions. Similarly, Bandaranayake and Jayasinghe (2014) examined the impact of bank-specific factors and variables of the operating environment on bank efficiency in Sri Lanka. Their study highlighted that net interest margin (NIM) is an efficient measure for evaluating the performance of private and foreign commercial banks. This finding suggests that optimizing and effectively managing net interest margins can contribute to enhancing the efficiency of these banks. Contrarily, Nitoi, and Spulbar (2015) found a negative relationship between net interest margin (NIM) and cost efficiency in emerging economies. It is crucial to note that this finding may not directly apply to the Nepalese banking sector. Therefore, further research is required to investigate whether NIM has a significant negative relationship with cost efficiency in Nepalese commercial banks.

H_5: There is a significantly negative relationship between the Net Interest Margin (NIM) and cost efficiency of Nepalese commercial banks.

3. Research Methods

This quantitative research study adopts a panel data approach to investigate the factors influencing the cost-efficiency of Nepalese commercial banks. By employing a descriptive and causal-comparative research design, the study aims to uncover pertinent information and establish causal relationships between the variables. Secondary data spanning from the fiscal year 2011/12 to 2020/21 were collected from Nepal Rastra Bank, ensuring a comprehensive analysis. The sample for this study comprises seven commercial banks out of the 22 operating in Nepal, with a data collection period of ten years. Careful consideration was given to avoid survivorship bias and data inconsistencies by selecting banks that had not undergone mergers during the study period. The selected banks include Nepal Bank Ltd. (NBL), Everest Bank Ltd. (EBL), Nabil Bank Ltd. (NABIL), Himalayan Bank Ltd. (HBL), Agriculture Development Bank Ltd. (ADBL), Nepal SBI Bank Ltd. (SBI), and Standard Chartered Bank Nepal Ltd. (SCBNL).

In addition to descriptive statistics, econometric models were used to explore the link between cost efficiency and independent variables like bank size, ROA, CAR, credit risk, and NIM.

Pooled Ordinary Least Square (OLS) Model: Pooled OLS regression is performed as a baseline comparison model as follows:

$$CE_{it} = \alpha_0 + \beta_1 BS_{it} + \beta_2 ROA_{it} + \beta_3 CAR_{it} + \beta_4 CR_{it} + \beta_5 NIM_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

where,

CE_{it} = Dependent variable i.e. Cost Efficiency of i bank at time t. It is measured as the sum of operating expenses divided by total income, which includes net interest income and non-interest income

BS_{it} = Bank Size of i bank at time t. It is measured as the natural logarithm of the values of total assets.

ROA_{it} = Return on Assets of i bank at time t

CAR_{it} = Capital Adequacy Ratio of i bank at time t

CR_{it} = Credit Risk of i bank at time t

NIM_{it} = Net Interest Margin of i bank at time t

α_0 = Constant

β_i = Regression coefficients for corresponding endogenous variables

ε_{it} = error term or residual

Here, i takes the value from 1 to 7 which represents the sample banks and t ranges from 2011/12 to 2020/21 which represents the study period.

Fixed Effects Regression Model (FEM): FEM assumes that each distinct effect is connected with the endogenous factors and that any variation in the intercept is due to different properties of the entity. One-way and two-way FEMs are described below:

One-Way Fixed Effects Model: Equation (i) assumes a constant intersection point, but in practice, the intersection point may vary depending on bank characteristics. Consequently, a one-way FEM has been run as follows to find the bank-specific effects:

$$CE_{it} = \alpha + \beta_{1t} BS_{it} + \beta_{2t} ROA_{it} + \beta_{3t} CAR_{it} + \beta_{4t} CR_{it} + \beta_{5t} NIM_{it} + \sum_{i=1}^{6} \delta_i \beta_i + \varepsilon_{it} \ldots\ldots\ldots \text{(ii)}$$

The model demonstrates that the intercept can vary depending on the bank-specific effects. The bank's dummy variable is represented by $\delta_i\beta_i$, where $\beta_i = 1$ if the cross-sectional unit is 1, otherwise 0; this formula is also used for the other dummies (β_i). Here, six dummy variables (the total number of sample banks minus one) are utilized to overcome the dummy variable trap, which is a circumstance of perfect collinearity.

Two-Way Fixed Effects Regression Model: For identifying bank-specific effects as well as time effects, this two-way effects model or time-variant model has been used. The model includes a time dummy in addition to the unit dummies in equation (ii) to account for time trends. So, a two-way effects model has been conducted as:

$$CE_{it}= \alpha+ \beta_{1t} BS_{it}+ \beta_{2t} ROA_{it}+ \beta_{3t} CAR_{it}+ \beta_{4t} CR_{it}+ \beta_{5t} NIM_{it}+\sum_{i=1}^{6} \delta_i\beta_i + \sum_{t=1}^{9} \delta_t T_t + \varepsilon_{it}\text{…….(iii)}$$

The term $\delta_t T_t$ represents a time dummy. The total number of time dummies used in the model is 9 as the total period used in this study minus one. Similarly, the one-time dummy has also been reduced to avoid the problem of the dummy variable trap.

Random Effects Regression Model (REM): REM presupposes that differences in intercepts are caused by randomness in sampling from a larger universe and that individual-specific effects are uncorrelated with independent variables. This model has been estimated to address the issue of having too many dummy variables as well as to overview the bank- and time-specific effects in the intercept term as in equations (ii) and (iii). Because each bank's intercept values vary individually, it is shown as "υ_{it}" in the error term. Consequently, the total residuals: $\omega_{it} = \varepsilon_{it} + \upsilon_{it}$.

The random effects model has been conducted as:

$$CE_{it}= \alpha+ \beta_{1t} BS_{it}+ \beta_{2t} ROA_{it}+ \beta_{3t} CAR_{it}+ \beta_{4t} CR_{it}+ \beta_{5t} NIM_{it}+ \delta_i \beta_i + \delta_t T_t + \omega_{it}\text{……...(iv)}$$

As a result, in the model above, $\alpha_i+\upsilon_i$ stands for the same thing as in model (ii), where υ_i stands for the specific variation in each bank's intercept values.

Diagnostic Tests: Diagnostic tests are performed to assess data characteristics and quality to find the best effect model for the study.

Variance Inflation Factor (VIF): Multi-collinearity creates difficulties in testing individual regression coefficients due to the presence of inflated standard errors. VIF is used for measuring the amount of multi-collinearity in regression analysis. The study tested if each variable had a VIF score of 10 or more, which suggests multi-collinearity.

Hausman Specification Test: In panel data analysis, it distinguishes between the FEM (Fixed Effects Model) and the REM (Random Effects Model) and recommends one over the other. The null hypothesis (H_0) states that the REM is superior to the FEM.

Breusch-Pagan Test: The Breusch-Pagan test is employed to ascertain whether there is the presence of heteroscedasticity or not in a regression model. The null hypothesis (H_0) asserts that there is the presence of homoscedasticity.

4. Data Analysis and Results

The proposed models were used to analyze the dataset, which contained information obtained from a sample of seven banks chosen from a population of 22 institutions. Table 1 depicts the descriptive statistics for dependent and independent variables, including minimum and maximum values, mean, and standard deviation.

Table 1: Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
Cost Efficiency Ratio (CE)	42.41	14.82	23.29	98.23
Bank Size (S)	11.55	0.44	10.64	12.58
Return on Assets (ROA)	1.86	0.63	0.30	3.57
Capital Adequacy Ratio (CAR)	13.78	4.50	-5.82	23.68
Credit Risk (CR)	91.23	14.40	78.80	173.51
NIM	3.60	0.94	1.54	5.76

Table 4 provides descriptive statistics. The cost efficiency ratio has a mean value of 42.41% (SD = 14.82%), indicating the level of operational efficiency in Nepalese commercial banks. Bank size has a mean of 11.55 (SD = 0.44), which reflects moderate bank size compared to industry benchmarks. Return on Assets has a mean of 1.86% (SD = 0.63%), suggesting a profitability level that can be compared to industry averages. The Capital Adequacy Ratio has a mean of 13.78% (SD = 4.50%), indicating a satisfactory level of capital adequacy. Credit Risk has a mean of 91.23% (SD = 14.40%), which suggests the banks' loan portfolio risk should be carefully managed. Net Interest Margin has a mean of 3.60% (SD = 0.94%), indicating the profitability from interest-earning activities.

Table 2: Correlation Analysis

	CE	S	ROA	CAR	CR	NIM
Cost Efficiency Ratio (CE)	1.000					
Bank Size (S)	-0.068	1				
	0.576					
Return on Assets (ROA)	-0.490^{***}	-0.148	1			
	0.000	0.222				
Capital Adequacy Ratio (CAR)	-0.417^{***}	0.337^{***}	0.379^{***}	1		
	0.000	0.004	0.001			
Credit Risk (CR)	-0.015	-0.268^{**}	-0.111	-0.077	1	
	0.900	0.025	0.360	0.525		
Net Interest Margin (NIM)	0.085	-0.201^{*}	0.687^{***}	0.133	-0.255^{**}	1
	0.483	0.096	0.000	0.272	0.033	

'' sign denotes the significance at 0.10 level (2-tailed),*
*'**' sign denotes the significance at 0.05 level (2-tailed),*
*'***' sign denotes the significance at 0.01 level (2-tailed)*

Table 2 reveals the correlations between different variables. The correlation coefficient between bank size and the cost efficiency ratio is -0.0679, suggesting no significant relationship (p-value = 0.5764). This indicates that the size of the bank does not have a significant influence on its cost efficiency. However, the correlation coefficient between the return on assets (ROA) and the cost efficiency ratio is -0.4904, indicating a significant negative relationship (p-value = 0.0000). This implies that higher ROA leads to a lower CE ratio ultimately associated with improved cost efficiency. Similarly, the correlation coefficient between the capital adequacy ratio (CAR) and the cost-efficiency ratio is -0.4174, showing a significant negative relationship (p-value = 0.0003). This implies that higher CAR is associated with enhanced cost efficiency. On the other hand, the correlation coefficient between credit risk and the cost efficiency ratio is -0.015, indicating no significant relationship (p-value = 0.9002). This suggests that credit risk does not have a significant impact on cost efficiency. Additionally, the correlation coefficient between the net interest margin (NIM) and the cost efficiency ratio is 0.0852, showing no significant relationship (p-value = 0.4830). Therefore, the findings indicate that ROA and CAR are important factors influencing cost efficiency in Nepalese commercial banks, while bank size, credit risk, and NIM do not significantly affect cost efficiency.

Panel data regression analysis was performed using the proposed models Pooled OLS, One-Way FEM, Two-Way FEM, and REM, and the results are displayed in Table 3.

Table 3: Comparison of Results of Different Regression Models

Variables	Pooled OLS	One-Way Fixed Effects	Two-Way Fixed Effects	Random Effects	VIF
Constant	31.542	17.290	-3.372	16.526	
Bank Size	0.737	4.509	6.402	3.407	0.707874
ROA	-22.646^{***}	-12.691^{***}	-11.291^{***}	-16.620^{***}	0.426614
CAR	-0.529^{*}	-1.733^{***}	-1.908^{***}	-1.250^{***}	0.681976
Credit Risk	0.075	0.063	0.098	0.070	0.819438
NIM	12.484^{***}	4.289^{**}	4.037^{*}	7.845^{***}	0.463948
du_EBL		18.662^{***}	18.219^{**}		
du_HBL		-10.566^{***}	-11.521^{**}		
du_NABIL		-3.692	-4.431		
du_ADBL		-13.604^{***}	-15.618^{**}		
du_SBI		3.367	2.546		
du_SCBNL		0.943	0.438		
dt_FY2012/13			-4.798		
dt_FY2013/14			-1.285		

Variables	Pooled OLS	One-Way Fixed Effects	Two-Way Fixed Effects	Random Effects	VIF
dt_FY2014/15			-3.067		
dt_FY2015/16			-7.836		
dt_FY2016/17			-1.651		
dt_FY2017/18			-0.443		
dt_FY2018/19			-3.717		
dt_FY2019/20			-3.867		
dt_FY2020/21			-1.725		
F- test	*F(5, 64)* =19.41	*F(11, 58)* =27.06	*F(20, 49)* =14.74	'Between'σ2 =0.440	
p-value	0.0000	0.000	0.000	'Within' σ2 =0.631	
R^2	0.603	0.837	0.858	χ^2 =91.99	
Adj. R^2	0.572	0.806	0.799	p-value χ^2 =0.000	

*'***' sign denotes the significance at 0.01 level. '**' and '*' signs denote the significance at 0.05 and 0.10 levels, respectively. For fixed effect models, du_NBL and dt_FY2011/12 were retained as benchmarks.*

Table 3 displays the results of various regression models, including the pooled OLS model, one-way FEM, two-way FEM, and REM. These models were used to assess the relationship between the variables and cost efficiency in Nepalese banks. Upon comparison, it was observed that Bank Size and Credit Risk did not exhibit a statistically significant relationship with cost efficiency. This suggests that changes in these variables do not significantly impact cost efficiency in the banking sector, despite their positive correlations. On the other hand, Return on Assets (ROA) was found to be the most influential factor across all models, showing a significantly negative relationship with cost efficiency. This implies that improving ROA can have a positive impact on cost efficiency. Additionally, the Capital Adequacy Ratio was found to have a significantly negative relationship, indicating its positive influence on cost efficiency. Conversely, the Net Interest Margin (NIM) exhibited a significantly positive relationship, suggesting a negative impact on cost efficiency.

In Table 3, both the pooled OLS model and fixed effects model were found to be statistically significant with a p-value less than 0.05. However, the fixed effects model demonstrated more significant impacts on the variables compared to the pooled OLS model. Moreover, the fixed effects model exhibited higher R^2 and adjusted R^2 values, indicating a better fit for the data. Therefore, the fixed effects model was deemed more suitable. The random effects model, presented in the table, also showed comparable robustness to the fixed effects models. To ascertain the best model between the fixed effects and random effects models, the Hausman specification test, displayed in Table 4, was conducted.

Table 4: Hausman Specification Test

	Chi-square (x^2)	P-value
Model: Bank-specific variables and cost efficiency	262.39	0.0000

The null hypothesis of the Hausman Specification (H_0) states that the random effects model is superior, while the alternative hypothesis (H1) posits that the fixed effects model is superior. As shown in Table 4, the obtained p-value is less than 0.05, suggesting the acceptance of the alternative hypothesis. Thus, the fixed effects model is deemed appropriate for this study. Further, among the one-way and two-way FEMs, the two-way FEM was selected based on its statistical significance and robustness. This model displayed an improved R-square value (0.858) compared to the one-way FEM (0.837), suggesting a better fit for the data.

After selecting the two-way FEM, the presence of heteroscedasticity was examined using the Breusch-Pagan (BP) test to validate the model's significance and the robustness of the results, as depicted in Table 5.

Table 5: Breusch-Pagan Test for Homoscedasticity

	Chi-square (x^2)	P-value
Model: Bank-specific variables and cost efficiency	2.88	0.0898

The Breusch-Pagan test holds the null hypothesis (H_0) stating that there is homoscedasticity. Table 5 indicates that the obtained p-value is greater than 0.05, indicating the acceptance of the null hypothesis that shows the presence of homoscedasticity in the data.

The selected two-way fixed effects model in Table 3 reveals several significant findings regarding the impact of different variables on the cost-efficiency ratio. Bank size (6.402) and credit risk (0.098) demonstrate a positive relationship with the cost efficiency ratio, although they are statistically insignificant, indicating that bank size and credit risk have no significant impact on cost efficiency. On the other hand, return on assets (ROA: -11.291) and capital adequacy ratio (CAR: -1.908) exhibit a negative relationship with the cost efficiency ratio and are significant at the 0.01 level, indicating that an improvement in ROA and CAR significantly enhances cost efficiency. Net interest margin (NIM) demonstrates a positive relationship with the cost efficiency ratio and is significant at the 0.10 level, suggesting a weakly significant negative impact on cost efficiency.

Table 3 also includes dummy variables for banks (d_u) and time periods (d_t). The results indicate that when the cost efficiency ratio of Nepal Bank Ltd. is 1, the cost efficiency ratio of du_Everest bank increases by 18.22, although it is significant at the 0.05 level. Similarly, efficiency increments are observed for SBI (2.546) and SCBNL (0.438), but they are statistically insignificant. Conversely, other banks (HBL, NABIL, ADBL) exhibit opposite relationships with Nepal Bank, and except for NABIL, their relationships are statistically significant. Furthermore, time dummies serve as benchmarks for FY 2011/12, revealing that when the cost efficiency ratio in FY 2011/12 is 1, the cost efficiency ratio in FY 2012/13 decreases by 4.798 and continues to decrease across all periods, although these changes are statistically insignificant.

The findings suggest that improving return on assets (ROA), capital adequacy ratio (CAR), and net interest margin (NIM) can significantly enhance cost efficiency in the banking sector. However, bank size (S) and credit risk (CR) do not exhibit significant impacts on cost efficiency. The relationships between different banks and periods also provide insights into their relative efficiency levels. The results of hypothesis testing have been summarized in Table 6.

Table 6. Summary of Hypothesis Testing

Hypotheses	Remarks
H_1: There is a significant relationship between bank size and the cost efficiency of Nepalese commercial banks.	Rejected
H_2: There is a significantly positive relationship between ROA and the cost efficiency of Nepalese commercial banks.	Accepted
H_3: There is a significantly positive relationship between CAR and the cost efficiency of Nepalese commercial banks.	Accepted
H_4: There is a significantly negative relationship between credit risk and cost efficiency of Nepalese commercial banks.	Rejected
H_5: There is a significantly negative relationship between NIM and the cost efficiency of Nepalese commercial banks.	Accepted

5. Conclusion

The results indicate that return on assets (ROA), capital adequacy ratio (CAR), and net interest margin (NIM) have significant influences on cost efficiency. A higher ROA indicates optimized revenue and resource utilization, leading to reduced expenses and enhanced cost efficiency. This finding aligns with previous studies by Nitoi and Spulbar (2015) and Hadhek et al. (2018), while it contradicts the research conducted by Oredegbe (2020). Similarly, a higher CAR allows banks to effectively utilize their capital and minimize costs, thereby enhancing cost efficiency. This finding supports prior research by Ereta et al. (2020) and Dahal and Bhaskar (2020). Additionally, NIM was found to have a significantly negative relationship with cost efficiency in Nepalese commercial banks. This finding is consistent with the study by Nitoi and Spulbar (2015). The negative relationship can be attributed to the impact of credit risk, which incurs higher interest rates, leading to increased interest income but reduced cost efficiency.

On the other hand, the study found no significant influence of bank size and credit risk on cost efficiency. These findings support the research by Stanek (2015) but contradict the studies conducted by Elahi and Poswal (2017) and Hadhek et al. (2018). It suggests that merely increasing the size of the bank does not improve cost efficiency, as profitability and cost depend on how effectively the bank utilizes its assets. Similarly, credit risk, while reducing potential losses, does not directly impact cost efficiency.

Based on these findings, it is recommended that banks should focus on enhancing ROA, CAR, and maintaining NIM to improve cost efficiency. Rather than emphasizing bank size, banks should prioritize optimizing revenue generation and resource allocation. Additionally, banks should adopt stringent loan screening processes and avoid aggressive lending practices to mitigate credit risk. The findings have implications for bank management and policymakers, highlighting the importance of strategic decision-making and resource optimization to achieve cost efficiency.

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References

Ab-Rahim, R., Md-Nor, N. G., Ramlee, S., & Ubaidillah, N. Z. (2012). Determinants of cost efficiency in Malaysian banking. *International Journal of Business and Society*, *13*(3), 355-374.

Adhikari, P. R. (2021). Efficiency, profitability, and stability of Nepalese commercial banks. *The Batuk, 7*(2), 15-36.

Adjei-Frimpong, K., Gan, C., & Hu, B. (2014). Cost efficiency of Ghana's banking industry: A panel data analysis. *The International Journal of Business and Finance Research*, *8*(2), 69-86.

Akrani, G. (2011). *What is bank? Introduction, definition, and features of bank.* Kalyan City Life. Retrieved from: https://kalyan-city.blogspot.com/2011/02/what-is-bank-introduction-definition.html

Amer, H. H., Moustafa, W., & Eldomiaty, T. (2011). Determinants of operating efficiency for lowly and highly competitive banks in Egypt. *Cambridge Business and Economics Conference, 1,* 1-35.

Bandaranayake, S., & Jayasinghe, P. (2014). Factors influencing the efficiency of commercial banks in Sri Lanka. *Sri Lankan Journal of Management*, *18*(1), 22-50.

Berger, M., & Humphrey, D. (1997). Efficiency of financial institutions: International survey and directions for future research. *Journal of Banking & Finance, 21*(7), 871-894.

Bergre, A. N., Hunter, W. C., & Timme, S. G. (1993). The efficiency of financial institutions: A review and preview of research past, present and future. *Journal of Banking & Finance, 17*(2-3), 221-249.

Bhandari, U., Yadav, S., Devkota, N., Paudel, U.R., Rajbhandari, S., & Karki, D. (2021). Private and public bank consumers' preference in Kathmandu Valley: Evidence from customers' satisfaction index. *International Research Journal of Science, Technology, Education, and Management*, *1*(1), 67-78. https://zenodo.org/record/5195755

Bhattarai, G., Karki, D., & Dahal, R. K. (2020). Psychological contract breach and organizational deviance behaviour: Mediating role of professional commitment. *Nepal Journal of Multidisciplinary Research*, *3*(3), 34–50. https://doi.org/10.3126/njmr.v3i3.34883

Bhattarai, S. (2015). Determinants of non-performing loans in Nepalese commercial banks. *Economic Journal of Development Issues*, *9*(1-2), 22-38.

Blankson, N., Anarfo, E. B., Amewu, G., & Doabil, L. (2022). Examining the determinants of bank efficiency in transition: Empirical evidence from Ghana. *Heliyon*, *8*(8), 1-11.

Casu, B., & Thanassoulis, E. (2006). Evaluating Cost Efficiency in Central Bank Branches: Evidence from the UK. *Journal of Money, Credit, and Banking*, *38*(4), 1013-1039.

Dahal, R. K., Bhattarai, G., & Karki, D. (2020). Determinants of technological and innovation performance of the Nepalese cellular telecommunications industry from the customers' perspective. *Advances in Science, Technology and Engineering Systems Journal*, *5*(6), 1013-1020. https://doi.org/10.25046/aj0506122

Dahal, S., & Bhaskar, P. K. (2020). A research report on cost efficiency and credit management variables of banking industry: A study on Sunrise bank and Siddhartha bank. *Research Journal of Science, Technology, and Management*, *2*(4), 43-58.

Elahi, M., & Poswal, B. A. (2017). Factors influencing cost efficiency in leading banks: A comparative study of banks operating in UK and Germany listed on London stock exchange. *International Journal of Scientific & Engineering Research*, *8*(1), 620-639.

Ereta, A. E., Bedada, E. Y., & Gutu, T. G. (2020). Determinants of banks' cost efficiency: A case study of selected commercial banks, Ethiopia. *Journal of Perspectives on Financing and Regional Development*, *8*(3), 231-244.

Esho, N. (2001). The determinants of cost efficiency in cooperative financial institutions: Australian evidence. *Journal of Banking & Finance*, *25*(5), 941-964.

Gajurel, D. (2010). Cost efficiency of Nepalese commercial banks. *SSRN Electronic Journal*, 1-32. Available at SSRN: https://ssrn.com/abstract=1657877 or http://dx.doi.org/10.2139/ssrn.1657877.

Hadhek, Z., Frifita, M., & Hamida, A. (2018). The determinants of cost efficiency of Islamic banks using SFA approach. *International Research Journal of Finance and Economics*, *168*, 33-47.

Karki, D. (2012). Economic impact of tourism in Nepal's economy using cointegration and error correction model. *Researchgate*, 1-12. Retrieved from https://www.researchgate.net/publication/ 276027809. http://dx.doi.org/10.13140/RG.2.1.4839.5684

Karki, D. (2017). Structural equation modeling of latent variables affecting stock prices: Evidence from Nepal. *Tribhuvan University Journal*, *31*(1-2), 25–44. https://doi.org/10.3126/tuj.v31i1-2.25329

Karki, D. (2018). The dynamic relationship between tourism and economy: Evidence from Nepal. *Journal of Business and Management*, *5*, 16–22. https://doi.org/10.3126/jbm.v5i0.27384

Maharjan, R., Devkota, N., Mahapatra, S. K., Paudel, U. R., Parajuli, S., Bhandari, U., & Karki, D. (2022). Consumers' preference on consumption of brandy among other alcoholic beverages in Kathmandu Valley, Nepal. *Quest Journal of Management and Social Sciences*, *4*(1), 42–57. https://doi.org/10.3126/qjmss.v4i1.45866

Maudos, J., Pastor, J., & Perez, F. (2002). Cost and Profit Efficiency in European Banks. *Journal of International Financial Markets, Institutions and Money*, *12*(1), 33-58.

Miller, C. (2022). *What is cost efficiency and how to achieve it?* Jaggaer. https://www.jaggaer.com/blog/what-cost-efficiency/

Neupane, B. (2013). Efficiency and productivity of commercial banks in Nepal: A Malmquist index approach. *Asian Journal of Finance & Accounting*, *5*(2), 220-243.

Nitoi, M., & Spulbar, C. (2015). An examination of banks' cost efficiency in central and eastern Europe. *Procedia Economics and Finance*, *22*, 544-551.

Ojeyinka, T. A., & Akinlo, A. E. (2021). Does bank size affect efficiency? Evidence from commercial banks in Nigeria. *Ilorin Journal of Economic Policy*, *8*(1), 79-100.

Oredegbe, A. (2020). Cost efficiency determinants: Evidence from the Canadian banking industry. *International Journal of Business and Management*, *15*(1), 86-91.

Stanek, R. (2015). Determinants of bank efficiency: Evidence from Czech banking sector. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, *63*(3), 1005-1011.

Sufian, F., & Habibullah, M. S. (2009). The Determinants of bank efficiency within a developing economy: Empirical evidence from Malaysia. *Applied Economics*, *41*(6), 711-729.

Tecles, P. L., & Tabak, B. M. (2010). Determinants of bank efficiency: The case of Brazil. *European Journal of Operational Researc*h, *207*(3), 1587-1598.

Williams, K. (2022). *Cost efficiency*. Study.com. https://study.com/learn/lesson/cost-efficiency-overview-analysis.html

Zeitun, R., & Benjelloun, H. (2012). The efficiency of banks and financial crisis in a developing economy: The case of Jordan. *International Review of Accounting, Banking & Finance*, *4*(2), 28-60.