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FACTORS INFLUENCING PROFITABILITY IN THE BANGLADESHI COMMERCIAL BANKING SECTOR

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Abstract

This study explores the determinants of Bangladesh-based commercial banks' profitability of commercial banks in an emerging economy, Bangladesh. For this study, commercial banks' annual report data [over the period 2013-2024] was used. Probable determinants were shortlisted using empirical literature. The study uses return on asset (ROA) and return on equity (ROE) as the dependent variable. Panel regressions were run using fixed effects model and random effects model. The findings show a significant positive relationship between asset quality and bank performance, and a significant negative relationship between capital adequacy and performance across all baseline models.

Keywords: ROA, ROE, Asset Quality, Bank Performance, Capital Adequacy, Fixed Effect Model, Random Effect Model.

Introduction

Banks are depository institutions that connect savers and users of funds. These intermediaries bridge the gap between final borrowers and lenders, enabling well-organized allocation of funds in the economy. Entities with excess funds can provide them to entrepreneurs and other economic units who need funds to take advantage of economically and financially feasible investment opportunities, earning a rational return. The presence of financial markets and financial institutions make such transfer of financial resources possible. As a result, both borrowers and lenders are better off compared to scenarios without financial organizations and intermediaries.

Financial institutions are argued to play an important role in funding and investment through a multidimensional process that involves numerous interconnected and interdependent factors of different natures. Assessing the contribution of each factor independently is difficult. The key purpose of financial institutions, along with other non-depository institutions, is to help distribute the country's scarce capital among various alternative investment areas. Thus, financial markets serve a dual role: they provide numerous types of investment funds and impose discipline on businesses that are inefficient and fail to pursue profitable income objectives. As commercial banks expand globally, it

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has become essential for financial regulators to safeguard the stability and sustainability of the banking system. It is observed that financial institutions, especially commercial banks, can support our economy's expansion if they are properly organized and directed.

In Bangladesh's context, efforts need to be designed to nurture banking activities and accelerate the economic development of the country. Despite its significant merits, it is also important not to overlook the problems within the nation's crisis-oriented banking structure, which requires appropriate guidelines for banking procedures to safeguard effective use and monitoring of business funds.

Literature Review

This chapter attempts to provide insight into various literature related to banks' asset quality, capital adequacy, and bank performance in both international and domestic contexts. It has been observed that numerous studies have been conducted using different methodologies across various countries and financial environments. The findings of these studies vary significantly, showing differences across countries regarding profitability, asset quality, and bank performance. Here the researcher has also identified several potential factors that may influence commercial banks' profitability, asset quality, capital adequacy, and other related matters.

This chapter offers a thorough review of literature on bank asset quality, capital adequacy, and overall performance in both international and domestic settings. Various studies have been carried out using different methodologies, reflecting the diversity of financial environments and regulatory frameworks across countries. Some researchers have used primary data sources, while others have relied on secondary data, leading to diverse findings.

Mendes and Abreu(2002) proposed that asset quality of bank could act as a potential rescue mechanism for banks in the future. In their examination of Nigerian banks, Al-Tamimi and A-Mazrooei(2013) stressed the importance of continuously analyzing and investigating factors that influence bank performance. Their results indicated ongoing underperformance in the banking sector, marked by high credit risk and an increasing number of bad loans.

Different studies indirectly link capital adequacy and Nonperforming loans to financial stability. The study of Ombaba(2013) on kenya's high NPL rates for nine years ,summary that for growth of economy and financial crises, stability of banking sector is a condition. That suggests that it is the bank level concern to manage NPL at microeconomic level.

Banks of Nigerian have highlighted the essential need for continuous analysis and investigation of factors affecting bank performance, especially given the persistent underperformance characterized by high credit risk and growing volumes of bad loans. Muhmad and Hashim (2015) recognized asset management as a major management concern for banks, observing that global surveys regularly highlight asset management quality as a common priority among bankers worldwide. Vighneswara(2015) found that

asset quality substantially influences a bank's ranking, with ratings and assessments of management closely linked to asset quality. Marshall (1998) reinforced this perspective, discovering that high quality assets are a characteristic feature of top performing banks, while poor asset quality frequently corresponds with lower bank ratings. Yixin(2005) noted an inverse relationship between non performing assets (NPAs) and bank income, highlighting the negative effect on overall bank performance. To protect investor interests, they recommended prudent credit risk management and strong asset protection strategies.

According to Poudel(2013) bank capital requirements are established to ensure institutions maintain sufficient capital levels to reduce risks related to asset growth, especially when assets are both profitable and inherently risk .This regulatory framework seeks to protect financial stability by balancing growth with careful risk management.

Ariyanti.,D.(2010),observed that quality of asset is measured by comparing the classification of credit, including doubtful, substandard and bad loans, with the total credit provided by the bank. This assessment offers understanding into the bank's capacity to manage its income generating assets. Ariyanti (2010) further noted that the main objective of allocating bank funds to productive assets is to generate expected revenue, emphasizing the significance of effective asset management in achieving financial performance.

Hashim and Muhmad (2015) performed an analysis of the CAMEL framework, consisting of capital adequacy, managerial competence, earnings quality, and liquidity, for both domestic and international banks operating in Malaysia from 2008 to 2012.

Researchers worldwide have used ratios of profitability to risk and solvency to liquidity to examine the success or failure of different financial organizations. These scholars included Abata, M. A. (2014) applied ten financial metrics to evaluate the effectiveness and efficiency of banking institutions. These parameters included credit risk ,profitability, and liquidity risk Marshall (1999), highlighted the importance of considering many factors when analysing a bank's level of performance.

Eyup et al (2018) investigated whether bad debts affect Turkish banks' profitability. They used regression analysis to examine a time series data set containing 180 observations. The relationship between bad loans or nonperforming and profitability, as measured by ROA and ROE, was found to be negative. Return on asset and return on equity were both low when asset quality was poor and bad loan or nonperforming loans were high. Eyup et al (2018) analyzed IFRS compliant quarterly financial reports from 55 Turkish banking sector banks. This study period covered the first quarter of 2006 to the third quarter of 2018. Asset quality was measured by the ratio of bad or non performing (follow up) loans to total assets. Based on the panel regression study findings, there was a significant inverse relationship between bad loan or nonperforming loans and the ROA/ROE ratio variable, a measure of bank profitability. A decrease in asset quality or a high number of bad loans could lead to bank bankruptcy during an economic crisis.

Ogbulu & Eze(2017) discovered that over the past 22 years, both domestic and international agencies had implemented regulations to assess asset quality in relation to its

importance. Revan (2000) conducted research on bank leverage (debt) and its drivers in the United Kingdom, where leverage was the dependent variable, while long term loans, short term debts, and retained earnings were the independent factors. Revan (2000) showed that debt (also called leverage) was negatively correlated with risky assets, long term debt, and short term debt. The Al Meklafi Study (2003) assessed indicators of capital adequacy, along with their effects on financial risk indicators, bank revenues, and bank valuations. The banking industry is vulnerable to interest rate risk, liquidity risk, and credit risk. Al Maleeji (2001) conducted research to create a model for evaluating Egyptian banks and to establish a standard that included various elements needed to assess capital adequacy. The model of Al Maleeji (2001) reflected most of the risks that commercial banks faced generally and credit, inflation, liquidity, and market risks specifically. Khreaiwsh et al. (2004) examined the different factors that determined the level of security maintained by Jordanian commercial banks over a certain time period (1994 – 2004). According to the research results, there was a strong positive relationship between banking security and ROA and ROE.

Banks were crucial to the expansion and growth of a nation's economy. The reason was that there was a positive relationship between the condition of the banking industry and economic growth (Levine and Beck 2005). Besides the Central Bank, governments, banking organizations, and other financial institutions, Management of bank was significant in understanding the correlation between capital adequate and financial sector performance. Without enough capital, financial industry could not operate efficiently.

There were various factors that contributed to having sufficient capital. Bevan, A. A., and Danbolt, J. (2000) and J. M. and Van Horne (2005) suggested that regulators could address moral hazard by focusing on capital adequacy regulation. The regulation of capital adequacy protected small depositors. Small depositors make up the majority of bank's funds, so this protection was very important.

Financial Sectors of Bangladesh

Bangladesh's banking sector demonstrates the nation's continuous commitment to achieving financial excellence. This overview highlights the compelling narrative of banking performance in this dynamic country. The Bank of Bangladesh (BB) predicted that the economy of Bangladesh would remain prosperous and stable in fiscal year 2024 provided these policies were upheld. It is noted that across all financial sectors, the banking sector's contribution exceeds the combined contributions of other sectors when considering total assets held relative to Gross Domestic Product (GDP). Commercial banks have had a substantial influence on the economy of Bangladesh throughout the years. They supply both the public sector and private industry with investable capital to speed up the nation's economic development.

Indicators of major performance of Banks in Bangladesh

Performance of bank can be assessed through various theoretical and analytical parameters. In this section, efforts have been made to highlight the key performance indicators of banks functioning in Bangladesh.

Capital Adequacy Ratio of Bangladeshi Banks

Adequate levels of capital adequacy indicate the extent of protection a bank offers to its depositors and other creditors against possible losses. The higher the capital adequacy ratio (CAR), the lower the insolvency risk for banks. In recent years, Bangladesh's banking sector has found it difficult to sustain the necessary level of capital adequacy because of several problems, including poor governance, elevated levels of non-performing loans (NPLs), etc. The Aggregate Capital Adequacy Ratio (ACAR) of banks in Bangladesh for the years 2014 to 2024 is displayed in Figure1 which shows the trend of capital adequacy ratio maintained by the banks.

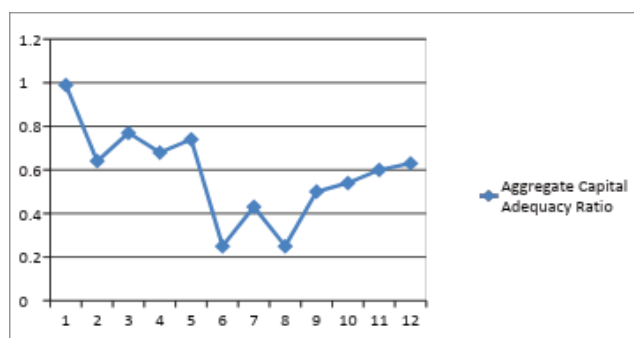


Figure1. Capital Adequacy Ratio

Source: Bangladesh Bank Annual Report, 2023

Based on the available data, the overall CAR for banks in Bangladesh stood at 9.90% in 2022 and increased to 11.04% in 2023. The aggregate CAR rose significantly to 12.30% in 2024 before remaining steady at 11.04% for the three years from 2015 to 2017. The aggregate capital adequacy ratio (CAR) of the banks rose to 13.10% in 2018, indicating that they have greater capital available to cover potential losses. The capital adequacy ratio has been displaying an upward trend from 2012 to 2024 as shown in Figure 1.

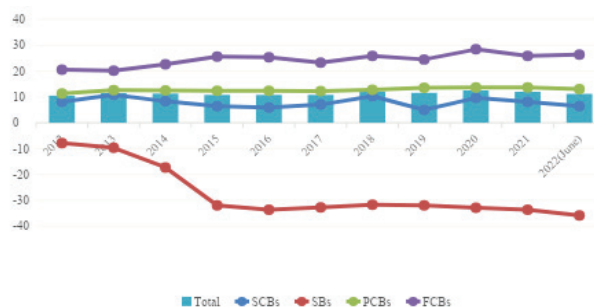


Figure 2. Capital Adequacy Ratio by Types of Banks

Source: Annual Report, Bangladesh Bank, 2022

Figure-2 shows that similar to the capital adequacy ratio by types of banks of Bangladesh follows the same pattern as the aggregate ROA. In 2013, it represented the strongest bank performance over the past 10 years, and in 2018 and 2020, the banks produced the lowest ROE (3.86% and 4.28%).

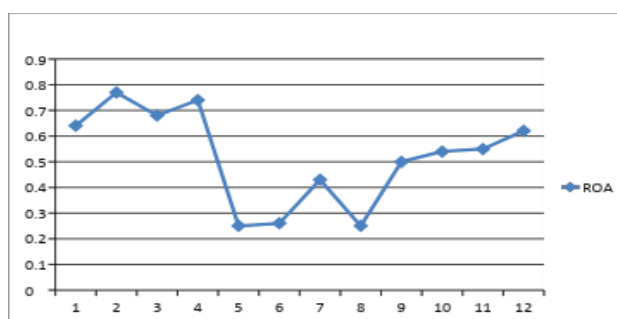


Figure 3. Aggregate Returns on Assets of Banks in Bangladesh

Figure-3 shows that similar to the ROA, the aggregate ROE of banks in Bangladesh follows the same pattern as the aggregate ROA. In 2013, it represented the strongest bank performance over the past 10 years, and in 2018 and 2020, the banks produced the lowest ROA (3.76% and 4.28%). Moreover it is encouraging that the ROA of the banks in the most recent year has risen almost double compared to the previous year.

1. Measurement of Return on Equity (ROE) and Return on Asset (ROA)

The profitability of banks can be assessed through Return on Asset (ROA) and Return on Equity (ROE). The performance of banks in Bangladesh over the past 10 years from 2014 to 2024 is presented in Figure 3.4 to provide an understanding of the banking industry performance in Bangladesh.

The trend of aggregate return on assets offers a summary of bank performance. In the trend analysis above, it is observed that the performance of banks has gone through fluctuating conditions. The performance of banks reached its peak in 2014 (0.80%) and hit its lowest point in 2019 and 2020 (0.24%). Overall, the performance of banks has declined by 0.15% from 2014 to 2024 which is not a positive indicator for banks in Bangladesh.

Table 1. Return on Assets (ROA) by Types of Banks (in percent)

Return on Asset ((ROA)										
Types	2014	2015	2016	2017	2018	2019	2021	2022	2023	2024 (June)
SCBs	0.58	-0.52	-0.07	-0.18	0.22	-1.34	-0.65	-1.17	-0.69	0.24
SBs	-0.4	-0.68	-1.17	-2.7	-0.65	-2.87	-3.32	-3.21	-3.13	-3.37
PCBs	0.97	0.99	1.01	1.04	0.90	0.79	0.78	0.72	0.66	0.58

FCBs	2.98	3.40	3.12	2.58	2.14	2.24	2.39	2.14	1.18	2.54
Total	0.9	0.64	0.77	0.68	0.76	0.25	0.45	0.26	0.26	0.55

Source: Annual Report, Bangladesh Bank, 2024

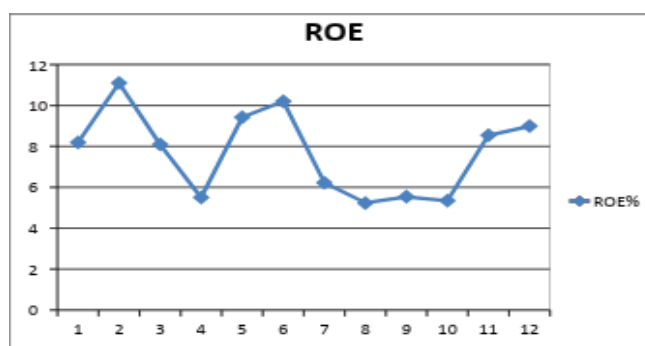


Figure 5. Return on Equity of Banks in Bangladesh

Source: Annual Report, Bangladesh Bank, 2024

In 2022, the ROE of the banking sector in Bangladesh has risen by 5.28% which also represents more than 100% growth, positioning it among the most profitable globally. Figure-6 offers an overview of the impacts caused by the epidemic. In 2019, the ROE for the industry stood at 7.73%, but it fell to 5.28% in 2020. However, the market showed a considerable amount of growth in 2022 as well, representing 9.37% of ROE. Except for SBs, all other banks experienced positive profitability growth. The profitability rose by 22.67% for SCBs, 6.89% for FCBs and 8.64.04% for PCBs.

Table 2. Return on Equity (ROE) by Types of Banks (in percent)

ROE										
Types	2014	2015	2016	2017	2018	2019	2020	2022	2023	2024(June)
SCBs	10.93	-13.43	-1.57	-6.12	3.46	-29.66	-13.69	-29.56	-21.67	5.44
SBs	-5.92	-5.98	-5.89	-13.87	-3.17	-13.47	-17.03	-13.88	-13.22	-13.98
PCBs	9.86	10.56	10.65	11.29	12.07	10.88	11.26	10.25	9.64	9.44
FCBs	16.97	17.77	14.57	13.09	11.33	12.44	13.33	13.15	7.89	16.12
Total	11.1	8.09	10.51	9.42	10.6	3.86	6.83	4.28	4.67	9.37

Source: Annual Report, Bangladesh Bank, 2024

The ROE of the banking sector in Bangladesh has risen by 4.18% which also represents more than 100% growth, positioning it among the most profitable globally. Table-2 offers an overview of the impacts caused by the epidemic. In 2019, the ROE for the industry stood at 6.43%, but it fell to 6.83% in 2020. However, the market showed a considerable

amount of growth in 2022 as well, representing 9.37% of ROE. Except for SBs, all other banks experienced positive profitability growth.

Among the four categories of banks, specialized private banks (SPBs) recorded the lowest ratio of nonperforming assets, reflecting stronger risk management practices. In contrast, stateowned commercial banks (SCBs) have long faced challenges in maintaining sound loan portfolios due to issues such as weak oversight, political influence, and limited accountability. To address the high levels of nonperforming loans in SCBs, Bangladesh Bank has introduced measures aimed at improving governance and operational efficiency

Methodology

The financial information used in this research consists of banking companies categorized as State-Owned Commercial Banks and National Private Commercial Banks in Bangladesh from 2012 to 2024, with both types having the following characteristics: they are not Islamic banks and the researcher has complete annual reports from 2012 to 2024. Based on the characteristics listed above, the number of banks that could fulfill the criteria were 84 banks, comprising 28 state-owned commercial banks and 64 national private banks. This research concentrated only on Bangladesh-based commercial banks; therefore quite naturally, data collection, interpretation of results. Research philosophy can be broadly divided into two streams – positivism and phenomenology. There exist slight differences between these two research philosophies according to three dimensions: axiology, ontology and epistemology. Philosophy of research actually guides the researcher through multiple stages – null hypothesis formation, data collection, interpretation of results. Research philosophy can be broadly divided into two streams – positivism and phenomenology.

The researcher attempted to focus on the profitability of commercial banks and that is why researcher selected only non-Islamic commercial banks. The researcher has utilized panel database. The research time period extended from 2012 to 2024. This panel database had both cross-sectional and time-series variations. Here researcher has conducted a series of regressions to determine the determinant factors of the profitability of commercial banks.

The panel data-based regression in order to capture the cross-sectional variance and time variance among the variables. Though it will be a short panel, it will be a balanced panel as well. It is expected that the collection of all the necessary data has been collected. Hausman test will be conducted to ascertain whether the researcher will go for a random effects model or fixed effects model. The panel regression will look like the following equation.

$$ROA_{it} = \alpha_j + \beta_j X_{it}^j + \beta_m X_t^m + \beta_n X_t^n + v_{it} \dots\dots\dots(1)$$

So, it is established through the panel regression that accounting profitability of commercial banks is dependent on three factors – bank specific factors, macro-economic factors and industry structure. Bank specific factors are as follows: business size, capital adequacy, asset quality, cost management and activity mix. In the above mentioned regression, notation ROA_{it} refers to the return on asset of a particular commercial bank

relevant for a particular year. X_{ict}^j , X_{it}^m , X_t^n refers to the vectors of commercial bank specific, macro-economy specific and industry specific determinants. V_{it} refers to the error part of the regression that covers for the effect due to the unobserved factors and the idiosyncratic errors as well (Bryman and Bell, 2011). The dynamic version of the model is as follows:

$$ROA_{it} = \alpha + \beta_j X_{ict}^j + \beta_m X_{it}^m + \beta_n X_t^n + v_{it} + \rho ROA_{it-1}$$

In the above mentioned model ROA_{it-1} refers to the one-period lagged dependent variable and refers to the speed of mean reversion whereby the adjustment co-efficient can move in between 0 to 1. Since, accounting profit often does not fit well with economic profit angle, the researcher will also explore the economic profit dynamics of commercial banking in Bangladesh. The generalized panel regression for understanding economic profit dynamics will look like the following equation.

$$ROE_{it} = \alpha + \beta_j X_{ict}^j + \beta_m X_{it}^m + \beta_n X_t^n + v_{it} \dots\dots\dots(2)$$

So, it is established through the panel regression that economic profitability of a commercial bank is dependent on three factors – bank specific factors, macro-economic factors and industry factors. In the above-mentioned regression, notation RE_{it} refers to the residual income of a particular commercial bank and relevant for a particular year. X_{ict}^j , X_{it}^m , X_t^n refers to the vectors of commercial bank specific, macro-economy specific and industry specific determinants. v_{it} refers to the error part of the regression that covers for the effect due to the unobserved factors and the idiosyncratic errors as well. The dynamic version of the model is as follows:

$$ROE_{it} = \alpha + \beta_j X_{ict}^j + \beta_m X_{it}^m + \beta_n X_t^n + v_{it} + \rho RE_{it-1}$$

In the above mentioned model RE_{it-1} refers to the one-period lagged dependent variable and refers to the speed of mean reversion whereby the adjustment co-efficient can move in between 0 to 1. The researcher will also try to understand the market perception of commercial bank's profitability through CAPE (cyclicality adjusted price-earning ratio). The generalized panel regression for understanding CAPE dynamics will look like the following equation.

$$CAPE_{it} = \alpha + \beta_j X_{ict}^j + \beta_m X_{it}^m + \beta_n X_t^n + v_{it} \dots\dots\dots(3)$$

So, it is established through the panel regression that market-determined price-earning multiple of a commercial bank is dependent on three factors – bank specific factors, macro-economic factors and industry factors. In the above-mentioned regression, notation RE_{it} refers to the residual income of a particular commercial bank and relevant for a particular year. X_{ict}^j , X_{it}^m , X_t^n refers to the vectors of commercial bank specific, macro-economy specific and industry specific determinants. v_{it} refers to the error part of the regression that covers for the effect due to the unobserved factors and the idiosyncratic errors as well. The dynamic version of the model is as follows:

$$CAPE_{it} = \alpha + \beta_j X_{ict}^j + \beta_m X_{it}^m + \beta_n X_t^n + v_{it} + \rho CAPE_{it-1}$$

In the above mentioned model $CAPE_{i,t-1}$ refers to the one-period lagged dependent variable and refers to the speed of mean reversion whereby the adjustment co-efficient can move in between 0 to 1.

Now the researcher will delineate the operational definition of the independent and dependent variable.

Table 3. Operational definition independent variables

Independent Variable	Operational definition	Expected Sign
Business Size	Natural logarithm of commercial bank's total asset	Positive/negative
Capital Adequacy	Tier 1 and tier 2 capital/risk weighted asset	Positive/negative
Activity Mix	Total non-operating income /total income	Positive
Asset Quality	Substandard, doubtful and bad and loss loan/ total loan	Positive
Net Interest Margin	(Interest income/ Interest expense) average earning assets	Positive
Market Structure	HH (Herfindahl- Hirschman) Index	Positive/negative
Cost Management	Natural logarithm of commercial bank's overhead	Positive
Term Structure of Interest Rate	Difference of yield spread of 10years and 5 years treasury bonds	Negative
Inflation Rate	% change in year-to-year CPI level	Positive/negative
Macro-Economic Growth Rate	% Change in annual GDP of Bangladesh	Negative

Source: Researcher

Table 4. Operational definition dependent variables

Dependent variable	Operational definition
ROA	Net income/total asset
ROE	Net income – (equity*cost of equity)
CAPE	Price/(10-year moving average of EPS)

Source: Researcher

Given, these pre-conditions in a single factor model, we can estimate beta estimators using the following way.

$$\begin{aligned}
\hat{\beta}_1 &= \frac{\text{Covariance}}{\text{Variance}} = \frac{\sum (y_i - \bar{y})(x_i - \bar{x})}{\sum (x_i - \bar{x})^2} = \frac{\sum (y_i (x_i - \bar{x}))}{\sum (x_i - \bar{x})^2} \quad [\text{Alternatively } \hat{\beta}_1 = \frac{Cov(x_i, y_i)}{\sum (x_i - \bar{x})^2}] \\
&= \sum \frac{(\beta_0 + \beta_1 x_i + u_i)(x_i - \bar{x})}{\sum (x_i - \bar{x})^2} \quad [\text{Note: in the population model: } Y_i = \beta_0 + \beta_1 x_i + u_i] \\
&= \beta_0 \frac{\sum (x_i - \bar{x})}{\text{var}(x_i)} + \beta_1 \frac{x \sum (x_i - \bar{x})}{\text{var}(x_i)} + \frac{u \sum (x_i - \bar{x})}{\text{var}(x_i)} \\
&= \beta_0 * 0 + \beta_1 \frac{\text{var}(x_i)}{\text{var}(x_i)} + \frac{\sum u_i (x_i - \bar{x})}{\text{var}(x_i)} \quad [\sum (x_i - \bar{x}) = 0; x_i(x_i - \bar{x}) = \text{var}(x_i)] \\
&= 0 + \beta_1 * 1 + \frac{\sum u_i (x_i - \bar{x})}{\text{var}(x_i)} \\
\hat{\beta}_1 &= \beta_1 + \frac{\sum u_i (x_i - \bar{x})}{\text{var}(x_i)}
\end{aligned}$$

There is no other way to simplify the expression any more. In order to simplify this expression further, the researcher is going to use expectation operator. By taking expectation operator in both the sides:

$$\begin{aligned}
E(\hat{\beta}_1) &= E\left[\beta_1 + \frac{\sum u_i (x_i - \bar{x})}{\text{var}(x_i)}\right] \\
&= E(\beta_1) + E\left[\frac{\sum u_i (x_i - \bar{x})}{\text{var}(x_i)}\right] = \beta_1 + \frac{E\left[\sum u_i (x_i - \bar{x})\right]}{E[\text{var}(x_i)]} = \beta_1 + \frac{E\left[\sum u_i (x_i - \bar{x})\right]}{\text{var}(x_i)} \quad [\text{note: } E(\text{constant}) = \text{constant}] \\
\rightarrow E(\hat{\beta}_1 | x_i) &= \beta_1 + \frac{E\left[\sum u_i (x_i - \bar{x}) | x_i\right]}{\text{var}(x_i)}
\end{aligned}$$

Since we are running a CLRM, the mean independence condition must have been fulfilled. And Mean independence: $E[u_i | x_i] = 0$; $E(u_i x_i) = 0$

$$\begin{aligned}
\rightarrow E\left[\sum (\hat{\beta}_1 | x_i)\right] &= \beta_1 + \frac{E\left[\sum (u_i x_i | x_i)\right]}{\text{var}(x_i)} * \frac{E\left[\sum (u_i x_i | x_i)\right]}{\text{var}(x_i)} \\
\rightarrow E\left[\sum (\hat{\beta}_1 | x_i)\right] &= \beta_1 + 0 \\
\rightarrow E\left[\sum (\hat{\beta}_1 | x_i)\right] &= \beta_1
\end{aligned}$$

By taking expectation operator in both the sides:

$$E[E(\hat{\beta}_1 | x_i)] = E[\beta_1]$$

$$E(\hat{\beta}_1) = \beta_1 \quad [\text{proved}]$$

This single factor regression model-based proof of unbiasedness can be extended in a multi-factor model and the research area of interest revolves around a multi-factor model [where commercial banks' profitability is dependent on a number of factors] (Wooldridge, 2015). So, the above-mentioned proof of unbiasedness is a legit framework in a multi-factor model.

Given, these pre-conditions in a single factor model, we can estimate beta estimators using the following way.

$$\begin{aligned}
\hat{\beta}_1 &= \frac{\text{Covariance}}{\text{Variance}} = \frac{\sum(y_i - \bar{y})(x_i - \bar{x})}{\sum(x_i - \bar{x})^2} = \frac{\text{Cov}(x_i, y_i)}{\sum(x_i - \bar{x})^2} \\
&= \frac{\text{Cov}(x_i, \beta_0 + \beta_1 x_i + u_i)}{\sum(x_i - \bar{x})^2} \quad [\text{Note: in the population model: } Y_i = \beta_0 + \beta_1 X_i + u_i] \\
&= \frac{\text{Cov}(x_i, \beta_0 + \beta_1 x_i + u_i)}{\text{Var}(x_i)} \\
&= 0 + \beta_1 \frac{\text{Cov}(x_i, x_i)}{\text{Var}(x_i)} + \frac{\text{Cov}(u_i, x_i)}{\text{Var}(x_i)} \quad [\text{Cov}(\text{constant}, x_i) = 0] \\
&= \beta_1 \frac{\text{Var}(x_i)}{\text{Var}(x_i)} + \frac{\text{Cov}(u_i, x_i)}{\text{Var}(x_i)} \quad [\text{Cov}(x_i, x_i) = \text{Var}(x_i)] \\
&= 0 + \beta_1 * 1 + \frac{\text{Cov}(u_i, x_i)}{\text{Var}(x_i)} \\
\hat{\beta}_1 &= \beta_1 + \frac{\text{Cov}(u_i, x_i)}{\text{Var}(x_i)}
\end{aligned}$$

There is no other way to simplify the expression any more. In order to simplify this expression further, the researcher is going to use plim operator. By taking plim operator in both the sides:

$$\begin{aligned}
\text{Plim } \hat{\beta}_1 &= \text{plim} \left[\beta_1 + \frac{\text{Cov}(u_i, x_i)}{\text{Var}(x_i)} \right] \\
&= \text{plim}(\beta_1) + \frac{\text{plim}[\text{Cov}(u_i, x_i)]}{\text{plim}[\text{Var}(x_i)]} \\
&= \beta_1 + \frac{0}{\text{Var}(x_i)} \quad [\text{note: } \text{plim}[\text{Cov}(u_i, x_i)] = 0] \\
&= \beta_1 \\
\hat{\beta}_1 &= \beta_1 \quad [\text{proved}].
\end{aligned}$$

The consistency proof in a single-factor regression model can be extended to a multi-factor framework. Since commercial banks' profitability depends on several variables, this approach offers a valid basis for analysis in multi-factor models (Woolridge, 2015).

Findings and Discussion

To estimate a determinant model for bank profitability, the researcher has conducted a number of panel regressions. Before conducting panel regressions, it was necessary to determine whether the estimated effects would be a random-effects or a fixed effects model. A fixed-effects model assumes that there exists cross-sectional heterogeneity in the dataset and it can be handled within the given structure. Conversely, in case of random-effects model, it is assumed that there exists no cross-sectional heterogeneity – a very restrictive and impractical assumption. By conducting the Wu-Durbin-Hausman test, one can also determine whether a fixed-effects model or a random effects model better suits the purpose. The null and alternative hypothesis related to the Wu-Durbin-Hausman test are as follows:

Null hypothesis: The given panel regression can be better explained by random effects

framework. Alternative hypothesis: The given panel regression can be better explained by fixed effects framework.

Based on a 95% confidence level, these hypotheses were tested. For all the regression models, the preferred model is fixed effects model. Panel regressions are conducted within the OLS framework and that is why panel regressions must meet certain OLS pre-conditions.

The estimated relationship between the factor and independent variable is linear. The data is collected through random sampling. The covariance (hence correlation) between independent variables and error is zero. There exists no perfect multicollinearity among the pairs of independent variables.

$$ROA_{i,t} = \alpha + \beta_1 \text{Firm-specific factors}_{i,t} + \beta_2 \text{Industry-specific factor} + \beta_3 \text{Macro-economic factors}_t + \beta_4 \text{Liquidity proxy}_{i,t} + \beta_5 \text{Managerial efficiency proxy}_{i,t} + \beta_6 \text{Labor market proxy}_{i,t} + a_i + \Delta_t + \varepsilon_{i,t}$$

In the above-mentioned model, ROA is the dependent variable and the researcher has tried to estimate a determinant model for ROA. $\varepsilon_{i,t}$ refers to the disturbance element and it can be decomposed into three sub-components such as – cross-sectional, time invariant heterogeneity (ϕ_i), time effect (δ_t) and noise ($\gamma_{i,t}$).

Table 5. Baseline Regression result

Variables	ROA
Size	0.00703**
	(2.069)
Capital Adequacy	-0.0568***
	(-7.454)
Activity Mix	0.0145**
	(2.057)
Asset Quality	0.000185
	(0.558)
NIM	0.611***
	(19.87)
HHI	0.177
	(0.397)
Cost Management	0.00537*
	(1.985)
Interest Rate	0.186
	(0.474)
Inflation	-0.00790
	(-1.111)

GDP Growth Rate	0.0895
	(1.398)
Constant	0.0375
	(0.673)
Observations	245
R-squared	0.747
Number of Firm Code	27
Firm FE	Yes
Firm Cluster	No
seasonal adjustment	No
R2 within	0.747
R2 overall	0.578
R2 between	0.0800
F-stat	67.97
Prob > F	0
t-statistics in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Complied by: The researcher

Interpretation of the second baseline regression:

- Theoretical framework: The researcher has tried to understand the relationship between economic profit and various firm-specific and macro-economic variables through regression.
- Regression magnitude and sign : The individual, factor-specific test of hypothesis was conducted by t-test. The null hypothesis [$H_0: \beta_1 = 0$] is rejected at 5% level of significance. It was found that activity mix, business size, cost management, interest rate, GDP growth rate, asset quality, net interest margin positively influenced the economic profit of commercial banks. It was also evident that capital adequacy and inflation rate negatively influenced the economic profit of commercial banks.
- R-square: It represents to the explanatory power of the model. It is around 13%; so 13% of the changes in the dependent variable (economic profit) can be explained by the combined changes in the independent variable.
- Model significance: It was hypothesized that the estimated model is not significant; so it was assumed that $H_0: \beta_1 = \beta_2 = \dots = \beta_{10} = 0$. This joint test of hypothesis was conducted through F-test and at a 5% level of significance this joint hypothesis was rejected. So, at least one of the factors is different from zero and it is a significant model to predict economic profit.

The baseline regression model can be represented through the following equation.

$$ROE_{i,t} = \alpha + \beta_1 \text{ Firm-specific factors}_{i,t} + \beta_2 \text{ Industry-specific factor} + \beta_3 \text{ Macro-economic factors}_t + \beta_4 \text{ Liquidity proxy}_{i,t} + \beta_5 \text{ Managerial efficiency proxy}_{i,t} + \beta_6 \text{ Labor market proxy}_{i,t} + \alpha_i + \Delta_t + \varepsilon_{i,t}$$

$$CAPE_{i,t} = \alpha + \beta_1 \text{ Firm-specific factors}_{i,t} + \beta_2 \text{ Industry-specific factor} + \beta_3 \text{ Macro-economic factors}_t + \beta_4 \text{ Liquidity proxy}_{i,t} + \beta_5 \text{ Managerial efficiency proxy}_{i,t} + \beta_6 \text{ Labor market proxy}_{i,t} + \alpha_i + \Delta_t + \varepsilon_{i,t}$$

In the above-mentioned model, CAPE is the dependent variable and the researcher has tried to estimate a determinant model for CAPE. $\varepsilon_{i,t}$ refers to the disturbance element and it can be decomposed into three sub-components such as – cross-sectional, time invariant heterogeneity (ϕ_i), time effect (δ_t) and noise ($\gamma_{i,t}$).

Table 6. Baseline Regression result

Variables	CAPE
Size	2.240
	0.626
Capital Adequacy	-2.7821
	(-0.8681)
Activity Mix	9.99*
	2.0032
Asset Quality	0.102
	(0.496)
NIM	8.0916
	(0.301)
HHI	99.6
	(0.276)
Cost Management	2.429
	(1.319)
Interest Rate	214.6
	(0.323)
Inflation	-4.852
	(-0.672)
GDP Growth Rate	23.72
	(0.382)
Constant	18.32
	(0.381)
Observations	245

R-squared	0.027
Number of Firm Code	24
Firm Fixed effect	No
Firm Cluster	Yes
seasonal adjustment	No
R2 within	0.03001
R2 overall	0.0358
R2 between	0.141
F-stat	0.822
Prob > F	0.004
t-statistics in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	
*** p<0.01, ** p<0.05, * p<0.1	

Complied by: The researcher

Interpretation of the baseline regression:

- e. Structural Foundation: Through regression, ROE and various firm-specific and macro-economic variables has relationship which was tried to understand
- f. Nature and scale of estimated effects: t-test conducted the individual, factor-specific test of hypothesis. The null hypothesis [$H_0: \beta_1 = 0$] is rejected at 5% level of significance. Activity mix, business size, net interest margin ,cost management, interest rate, GDP growth rate, asset quality, positively influenced the ROE of commercial banks. It was also evident that capital adequacy and inflation rate negatively influenced the ROE of commercial banks.
- g. Regression model: It refers to the explanatory power of the model. It is around 3%; so, 3% of the changes in the dependent variable (ROE) can be discussed by the changes in the independent variable.
- h. Significance Model: It was hypothesized that the model is not significant; so, it was assumed that $H_0: \beta_1 = \beta_2 = \dots = \beta_{10} = 0$. This combined test of hypothesis was established through F-test and at a 5% level of significance this combined hypothesis was rejected. So, the factor is different from zero and ROE was predicted to be significant in this model . After reviewing the literature, there is a significant number of bank-specific and macro-factors that have an impact on commercial bank's profitability. The study present the baseline regression results where the partial effect of various factor variables on banks' profitability was assessed along with these two omitted variables.

$$ROA_{i,t} = \alpha + \beta_1 \text{ Firm-specific factors}_{i,t} + \beta_7 \text{ Industry-specific factor} + \beta_j \text{ Macro-economic}$$

$\text{factors}_t + \beta_{11} \text{Liquidity proxy}_{i,t} + \beta_{12} \text{Managerial efficiency proxy}_{i,t} + \beta_{13} \text{Labor market proxy}_{i,t} + a_i + \Delta_t + \varepsilon_{i,t}$

$\text{ROE}_{i,t} = \alpha + \text{Firm-specific factors}_{i,t} + \beta_7 \text{Industry-specific factor} + \text{Macro-economic factors}_t + \beta_{11} \text{Liquidity proxy}_{i,t} + \beta_{12} \text{Managerial efficiency proxy}_{i,t} + \beta_{13} \text{Labor market proxy}_{i,t} + a_i + \Delta_t + \varepsilon_{i,t}$

$\text{CAPE}_{i,t} = \alpha + \text{Firm-specific factors}_{i,t} + \beta_7 \text{Industry-specific factor} + \text{Macro-economic factors}_t + \beta_{11} \text{Liquidity proxy}_{i,t} + \beta_{12} \text{Managerial efficiency proxy}_{i,t} + \beta_{13} \text{Labor market proxy}_{i,t} + a_i + \Delta_t + \varepsilon_{i,t}$

Table 7

VARIABLES	Model 1	Model 2	Model 3
	ROA	ROE	CAPE
Size	0.0069	0.0053	0.006
	3.00867	0.6572	0.95106
Capital Adequacy	-.990332*	-6.18	-4.72651*
	-2.0092	-3.714	-3.2811
Activity Mix	0.03135	1.34E+09	16.457
	2.89861	2.01252	2.2692
Asset Quality	3.025**	3.989*	6.1362**
	.79794	.25334	.51876
Net Interest Margin	0.87373	3.22E+09	1.36996
	2.4131	1.62498	0.40431
HHI	-0.25311	-8.43+10	-3.096
	-0.56914	-3.05068	-0.36156
Cost Management	0.006249	2.302	3.31299
	2.69555	0.16006	1.72789
Interest Rate	-0.26026	-2.61010	-0.126
	-0.60632	-0.97944	-0.42313
Inflation	-0.01101	-4.8908**	-5.04612**
	-1.58873	-1.13526	-0.88032**
GDP Growth Rate	0.127699*	4.6309**	2.4532*
	1.85614	.08438	-.50042
Liquidity	-.564764	-3.005	-2.06048
	-1.31571	-2.1253**	-0.203**
Managerial efficiency	0.02389	0.987	2.32214

	3.44754	2.46351	0.3255
Labor efficiency	0.276107	0.008	3.45254
	4.02782	2.3531	0.24302
Constant	-2.0980	-3.9890	-2.520
Observations	245	245	245
R-squared	0.342	0.219	0.251
Number of Firm Code	29	29	29
Firm fixed effects	Yes	Yes	Yes
Firm Cluster	No	No	No
seasonal adjustment	Yes	Yes	Yes
R2 within	0.017	0.052	0.034
R2 overall	0.076	0.015	0.032
R2 between	0.231	0.256	0.312
F-stat	6.020	4.045	5.067
Prob > F	0.005	0.006	0.024
t-statistics in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Compiled by: The researchers

Correlation Matrix

Table:8 shows that return on asset(ROA) is negatively correlated with net interest margin(NIM),return on equity (ROE),capital adequacy ,market structure and asset quality(AQ),activity mix, nonperforming loan(NPL),inflation and negatively correlated with cost management, total asset, leverage ,loan loss provision, and GDP, Return on asset and return on equity are positively correlated with NIM ,ROE, NLP and GDP. From table 8 it is strongly represent the proxies of profitability used in this study are negatively related to the proxy of cost management. So, this can be mentioned from the relationship of the variables that a bank uses NPL to pursue their interest directly or indirectly, can affect the financial efficiency negatively.

Table 8. Represents the correlation coefficient of the variables used in the study of commercial banks from2022 to2024.

Variables	1	2	3	4	5	6	7	8	9	10
1. Business size	1									
2. Capital adequacy	0.47	1								
3. Activity mix	0.43	0.87	1							

4. Asset quality	-0.1	-0.2	-0.1	1						
5. Net interest margin	0.4	0.88	0.78	0.88	1					
6. Market structure	0.23	0.45	0.67	-0.6	0.9	1				
7. Cost Management	-0.1	-0.1	-0.3	-0.3	-0.4	0.24	1			
8. Term structure of Interest	-0.2	0.42	0.56	0.45	0.6	0.45	0.58	1		
9. Inflation	-0.1	-0.2	-0.3	0.67	0.9	0.38	0.78	0.7	1	
10. Macro-economic growth rate	0.02	0.07	0.09	0.34	0.5	0.27	0.53	0.3	-1	1

Here the main objective of the analysis will be to understand how commercial bank operating in Bangladesh makes profit and how to make that profit sustainable in the longer run. For that reason, the researcher will conduct a positivism driven research study; where secondary data will be used to understand the profitability dynamics. Systematic panel data regression will be the data analysis tool.

Table 9. Out of sample predictability

Machine learning tools	Accuracy score	Training-testing split	Target variable
Regression Logistic	87%	75%-30%	ROA[transformed]
Forrest Random	76%	75%-20%	ROA[transformed]
Machine Support vector	65%	75%-20%	ROA[transformed]
Decision-tree	73%	72%-25%	ROA[transformed]

Compiled by: The Researchers

The baseline model has achieved memorable accurate scores in predicting the profitable direction in the out-of-the-sample contexts. Here the analysis of three fixed-effects regression models represent relationship between dependent variables and independents variables, with different degrees of value and significant model. This factor-specific test of hypothesis was conducted by t-test. The null hypothesis [$H_0: \beta_1 = 0$] is rejected at 5% level of significance. Bank performance and asset quality is related positively which was evident and this regression model was significant. On the other hand, banks' performance and capital adequacy performance is negatively related which was observed and in case of all the baseline regression models, the regression coefficient is significant, once the omitted variables were introduced in the models. Overall baseline models are statistically significant which is mentioned in this study.

Conclusion

Commercial banks play a crucial role in fostering a nation's economic growth by channeling capital into productive investments. Actual rising competition, increasing risk exposure, and rapid technological change, these institutions must strengthen their efficiency

to remain resilient and effective. It is difficult and challenging task to manage a bank. The challenge has become greater because of the recent structural changes in the environment, economy, technology, competition, financial liberalization and relaxation or inclusion of new rules and regulation in which a bank operates. Hence, focus is given to the managerial techniques that help optimize the trade-off between risk and return of a bank within the constraint imposed by its environment in managing its funds and investments. Bangladeshi bank is observed to be alarming as maximum bank do not have any investment at all due to economic problems and political unrest they are unwilling to invest. This is a crucial factor that directly affecting profitability as well. The sequence of this analysis suggests that Bangladesh cannot adopt bank based economic structure due to some differences in corporate practices in the economy of country. For this purpose proper regulation of the banking operations is required to mitigate the current crisis ridden banking system of Bangladesh. Moreover internal efficiency and proper and efficient use of funds should be ensured.

The substantial features and contribution of this research are provided below:

Based on the PCA results, it was concluded that ‘dimension reduction’ would not be an appropriate approach to understanding the profitability determinants of Bangladesh-based commercial banks since the first two principal components can together explain only 46% of the total variation.

This research designed three regression models for the profitability of Bangladesh-based commercial banks. Commercial bank’s profitability was through three perspectives: accounting profit (ROA), CAPE(residual income), and the market’s perception of profit (ROE). It was clear that some bank-specific factors, macroeconomic, and commercial industry-specific variables were involved with commercial banks’ profitability.

The regression results showed that factors like activity mix, business size, GDP growth rate, cost management, interest rate, net interest margin negatively impacted commercial banks’ profitability. On the other hand, capital adequacy, asset quality and inflation rate were found to positively affect accounting profitability.

Research findings indicate that variables such as organizational scale, diversification of operations, expense control, lending rates, national economic expansion, asset quality, and net interest yield contribute positively to the financial performance of commercial banks. Conversely, capital sufficiency and rising price levels were shown to exert a detrimental influence on economic returns.

This research confirmed that the estimated relationships remain the same across different model specifications, as the movement of the coefficients and their statistical significance are not changed when using a random effects approach. Furthermore, the findings proved consistent in out-of-sample testing, using a 60%-80% training-to-testing partition. Furthermore, results indicated that asset quality continued to show a negative relationship with bank performance, while capital adequacy maintained a positive relationship with both effects remaining statistically significant across all baseline models

under alternative definitions. No evidence of cross-sectional heterogeneity was detected in the estimated results.

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