Bank Capital on Lending and Profitability: Empirical Evidence on Commercial Banks in Bangladesh

Billal Hossain, CFA[1]

Abstract:

This paper empirically investigates the effect of bank capital on lending and profitability of commercial banks in Bangladesh. The capital adequacy ratio (CAR) is employed to assess the capital strength of banks, taking into account both Tier-1 and Tier-2 capital components. Loan to total asset is used as the measurement of lending, whereas, for measuring Return on Assets (ROA), profitability is used. OLS, RE, FE and FGLS econometric models are applied. To deal with endogeneity, the IV approach is applied as well. These different models provide consistent results. Capital appears to negatively impact both lending and profitability, according to the findings. This is consistent in both situations where capital is measured by Tier-1 and Tier-2 capital, and capital is measured by only Tier-1 capital. Hence, this paper suggests that the bank's capital negatively affects the lending and profitability of commercial banks operating in Bangladesh.

Keywords: Bank capital, Risk weighted asset, BASEL III, Lending, Profitability

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1.0 Introduction

While banks operate in a tightly regulated environment, the capital regulation of banks is of absolute importance. After the financial crisis of 2008-09, regulators, policymakers, and academicians considered that financial stability is crucial in the banking system and took steps accordingly. BASEL III is a result of this effort and is currently considered the most important financial strength determinant of banks. Following the global trend, Bangladesh is also implementing the BASEL III accord. In 2014, Bangladesh Bank, the regulator of the banking industry, issued a roadmap for banks that by December 2019, it required them to maintain a minimum 12.5% capital adequacy ratio (CAR) against their risk-weighted asset, which was 10% in

[1] Lecturer, Department of Finance, Faculty of Business Studies, University of Dhaka, Dhaka, Bangladesh, E- mail: billalhossain@du.ac.bd

BASEL II. This research explores how bank capital influences lending activities and the profitability of banks.

Banks have to follow regulations to maintain minimum capital that can measure the financial strength of banks, and they can increase additional capital that can be used to give loans as well. A bank can collect funds for lending from two broad sources: deposits from customers and capital from owners. The deposit can be of many types, such as current deposit, savings deposit, fixed deposit. However, the bank needs to keep cash reserve ratio (CRR) as well as statutory liquidity ratio (SLR) based on the deposit collection. While these rates are set by the Bangladesh Bank, CRR and SLR can vary from time to time based on the economic conditions. Meanwhile, banks also maintain advance deposit ratio (ADR). CRR, SLR, and ADR vary based on whether the bank is a conventional or Shariah-based bank. While banks cannot provide 100% loan from deposits, they can provide the full amount of loans from their capital. This offers more flexibility to banks. Because of the greater capital buffer, a bank can make more loans with a higher capital ratio.

Although higher capital enables banks to lend more, they are still required to maintain a minimum level set by the CAR regulation. This CAR is based on the risk-weighted assets. Hence, higher capital cannot be used for higher lending. When loan demand is high, if the bank capital rises, this rise can be caused by higher loan demand, or it can be caused by the regulatory capital requirement. Hence, this study examines the question: Does bank capital affect bank lending? If yes, what is the magnitude of this impact? The related policy implication is that when the economy requires credit, the bank will try to increase its capital base to support this higher lending demand. Additionally, this paper analyzes how bank capital impacts bank profitability, as there is no benefit of higher lending if the performance of the bank is not satisfactory or not improving. It is widely accepted that if any bank has an adequate capital base, the bank has a strong capacity to absorb any negative shock. Bank capital has four basic functions: (i) it cushions the institution against potential losses, (ii) it fosters trust among depositors, (iii) it signals the degree of risk exposure that the bank's owners are prepared to accept, and (iv) it represents how much the bank utilizes low-cost funding options. For this reason, investigating the catalysts of profitability, especially bank capital, is salient.

Return on asset (ROA) is used as the measurement of profitability in this paper. If the cost of financing is lower, the bank can earn higher profit, which helps the bank experience higher profitability. In terms of capital, banks can benefit from a lower cost and the absence of mandatory repayment obligations. But in the case of deposit,

the bank must fulfil this interest obligation. So, banks can enjoy added benefits in the case of capital. Moreover, interest is deducted from income, which lowers the bank's profit and reduces profitability in case of higher deposit costs. But in the case of capital, there is nothing to report in the income statement, which helps the bank earn a higher profit. So, bank capital is an important source of funds that can help banks earn greater profit than deposits. This higher profit helps the bank to promote its performance.

In conclusion, a bank cannot operate effectively without adequate capital. Unlike deposits, which are subject to regulatory constraints such as CRR, SLR, and ADR, capital can be fully utilized for lending purposes. Furthermore, returns provided on capital do not diminish the bank's profit. Thus, capital is closely linked to both a bank's lending capacity and its profitability.

There are more than 60 scheduled banks in Bangladesh. Out of them, 33 scheduled banks are listed (till 2022) on the Dhaka Stock Exchange (DSE). This study was started in 2023, when the financial statement of 2022 had not been published yet. Up to 2021 data were available at that moment, and to ensure consistency (the last 10 years), this paper analyzes these 33 listed commercial banks from 2012 to 2021, where all these 33 listed banks' data were available. This period also covers the landscape of regulatory capital requirements of BASEL II and III. Here, Tier 1 and Tier 2 capital are used as capital, loan to loan-to-total asset is considered as the lending and for profitability measure and ROA is taken.

There are two methodological parts of this study. This study initially investigates the impact of bank capital on lending by employing various econometric approaches, including Fixed Effects, Ordinary Least Squares (OLS), Random Effects, Feasible Generalized Least Squares (FGLS), and models with Year Fixed Effects. Second, it examines the impact of lending on profitability, using OLS, Random Effect, Fixed Effect, FGLS, and Year Fixed Effect models. The reason for using various models is to get robust results. In this study, we find that capital negatively affects both lending and profitability. There is no study conducted in Bangladesh on this area previously, and this study considered the endogeneity issue in this paper.

This paper consists of six parts. In first part contains an introduction to the paper. In the second part, the related literature review is presented. In the third part, the paper discussed the required data, data source, data descriptions, and analytical tools. An empirical framework is provided in part four, where the definition of the variables, econometric models, and other relevant issues are discussed. In the fifth part, the

empirical findings of this study are discussed in detail. Finally, the conclusion of the paper is presented in part six.

2.0 Literature Review

The extent literature has conducted empirical studies examining the effect of bank capital on lending and profitability separately. In contrast, this paper has considered two crucial factors focusing on the listed commercial banks in Bangladesh. Given the significance of bank capital's influence on lending and profitability, it is important to explore it within the context of Bangladesh as an emerging market.

2.1 Effect of Bank Capital on Lending

Most empirical studies are conducted on capital and its effect on lending find a positive outcome, although the degree of positivity varies. Bernanke et al. (1991) developed statistical-level equations that relate the bank loan's growth to bank capital. Their findings suggested that a one-percentage-point rise in bank capital corresponds to an increase in loan growth of about 2 to 3 percentage points. Similarly, Furlong and Frederick T. (1992) identified that bank loan growth and the target capital to bank capital ratio are positively related. Hancock et al. (1994) also find that bank capital positively affects lending. However, a model developed by Hancock et al. (1994) is complex and problematic due to the mis-specified equation.

Berger and Udell (1994) developed a model that identified the measurement of different bank capital ratios as being related to the growth of different bank assets. Peek and Rosengren (1995) examined the impact of a shock to capital on credit supply by comparing affected and unaffected banks. Jackson, et al. (1999) examined whether the regulatory capital requirement increases the ratios of capital ratios and did not find a relationship that the capital requirement causes a higher capital ratio in banks. Jackson et al. (1999) discovered that the possible reason for the reduction in lending is that the external shock to capital implies that a lower capital ratio hinders banks from providing more credit or lending in the economy. Furfine and Craig. (2001) finds that the reason for the 1990s credit crunch is the capital regulation and its influence on the allocation of banks' optimal portfolio. The strong relationship between lending and bank capital is the key outcome of managing capital ratios actively using portfolio composition found by Furfine and Craig. (2001).

Based on UK and Italian banks, Gambacorta et al. (2004) identify a significant and positive effect between lending and excess capital. Berrospide et al. (2010) find that when the bank capital ratio improves by 1%, loan will grow by approximately 0.7%

to 1.2%. Meanwhile, Elliott (2007) identifies that capital ratios have a small effect on loan volume and pricing for US banks. However, De Nicolo and Lucchetta (2010) suggested that fluctuations in bank lending cycles are primarily driven by changes in credit demand. Carlson et al. (2011) observe a significantly positive impact of capital ratio increase and loan growth, although it is not significant economically. Using 2001 to 2009 US banks' data, they determine that when the capital ratio increases by 1%, the loan will grow by approximately 0.05% to 0.2% annually. It is also observed that capital is more crucial during crisis periods like 2008 and 2009.

Bolton et al. (2016) find that local banks in Italy have a higher capital ratio, and they cut lending less after the financial crisis. Karmakar and Mok (2015) evaluated the effect of bank capital on lending using data from US commercial banks. They used two different measures of bank capital, namely CAR and Tier 1, and applied the instrumental variable (IV) approach to overcome the endogeneity issue. Finally, Karmakar and Mok (2015) found that lending and bank capital are positively related, consistent with the broader part of the empirical evidence in this research area. Schelling and Towbin (2022) suggest that changes in the marginal effect of the Capital Adequacy Ratio (CAR) on Swiss banks' lending may be statistically insignificant. Eggertsson et al. (2024) introduce the marginal funding cost channel and the bank capital channel as fundamental drivers influencing the expansion of bank lending activity.

2.2 Effect of Bank Capital on Profitability

The second part of this report evaluates the impact of bank capital on profitability. Molyneux and Thornton (1992) conclude that higher bank capital positively impacts bank performance, as capital with lower costs enables managers to generate increased profits through diversified investment strategies. Molyneux and Thornton (1995) also find similar results.

Athanasoglou et al. (2008) identified a positive relation between the profitability of banks and capital. Similarly, Flaminiet et al. (2009) show the positive impact of bank capital on banks' profitability. Berger and Bouwman (2013) conclude that small banks' performance is influenced by bank capital, as it enables banks to survive. Bank capital also enhances the performance of large and medium-sized banks, especially during financial crises. A positive relationship was observed in the case of Asian countries' commercial banks' capital and profitability (Lee and Hsieh, 2013). Ozili P. (2017) concludes that regulatory capital has a positive relationship with the profitability of African commercial banks.

Unlike some findings, Tran et al. (2016) did not observe a straightforward linear connection between bank capital and performance. Their study revealed that while larger banks tend to show an inverse relationship between profitability and capital, smaller banks exhibit a positive correlation. Meanwhile, Bitar et al. (2018) explored the impact of stricter capital ratio requirements on banking institutions, finding that both risk-based and non-risk-based capital ratios play a beneficial role in improving profitability and reducing risk. Similarly, Batten and Vo (2019) emphasize the significant influence of bank capital on both profitability and risk management. Do and Vu (2019) highlight the importance of capital adequacy in maintaining profitability for Vietnamese banks, through its positive effect on return on assets (ROA).

Barth et al. (2008) also cannot determine a clear regulatory capital effect on bank profitability. However, a negative relationship is found between bank capital and profitability by various researchers such as Boyd & Runkle (1993), Naceur (2003), Micco, Panizza, & Yanez (2007), and Francis M. (2013). The results are mixed, hence inconclusive.

Ayaydin and Karakaya (2014) use Turkish bank data, considering ROA and ROE to be the determinants of profitability or performance, and observed that a positive relationship exists between performance (profitability) and the capital of the bank. This finding is consistent with the results of studies by Mehzabin et al. (2023), Ikpesu and Oke (2022), Hosen et al. (2021) and Derbali (2021), all of which conclude that bank capital positively influences profitability.

Shah Naoaj (2023) finds that in Bangladesh, a positive correlation exists between real GDP, net profit and capital adequacy. A study conducted on Bangladeshi banks by Shah Naoaj and Hosen (2023) identified that strengthening capital maintenance and improving the quality of capital are essential for promoting the long-term sustainability of banks and safeguarding the overall stability of Bangladesh's financial sector. Another study by Rani et al. (2015) found a negative relationship between bank capital and return on equity in Bangladesh. However, this research ignores the endogeneity issue.

In sum, while most of the research conducted on the impact of bank capital on lending and performance has been conducted separately, to my knowledge, no study has been conducted on this topic from a Bangladesh perspective. Based on the role of lending discussed in the introduction part, as well as empirical findings, two hypotheses of the research are:

H_1: Bank capital positively affects lending

H_2: Bank capital positively affects profitability

As an emerging economy, Bangladesh has been experiencing rapid economic growth, with the banking sector playing a significant role in contributing to the country's GDP. Bank-provided loans are crucial in supporting business operations, fostering business expansion, generating employment, and ultimately driving national economic development. Therefore, examining the impact of bank capital on lending behavior and profitability in Bangladesh can offer valuable insights for both regulatory policy formulation and effective bank management.

3.0 Data

3.1 Types of Data and Data Sources

In Bangladesh, 61 scheduled banks are operating. In the Dhaka Stock Exchange (DSE), 33 banks are listed out of the 61 banks. This paper analyzes these 33 banks from 2012 to 2021 (10 years). All 33 banks' data are available for this period, except for three banks, as those were established in 2013. Due to the use of some lag variables, the total observations are 324. Data is collected from annual reports of local banks, the website of Bangladesh Bank, and the World Development Indicators. Some data are calculated, and some are directly used from these sources.

3.2 Variable Matrix

In this paper, two regression models are applied. First, lending is used as the dependent variable, which is the loan-to-total-assets ratio. Secondly, bank profitability is used as the dependent variable; return on assets (ROA) is used as its proxy. Capital is also measured in two ways: (i) capital which consists of both Tier-1 and Tier-2 capital, (ii) only Tier-1 capital. Some control variables are used to reduce the omitted variable bias. The analysis includes control variables grouped into two categories: bank-specific factors and macroeconomic indicators. In the first model, the bank-specific controls include non-performing loans (NPL) and liquidity, both taken with a one-year lag. The second model incorporates lending and NPLs as bank-level indicators. Across both models, macroeconomic controls consist of the annual GDP growth rate and the national inflation rate.

3.3 Correlation Matrix

A correlation matrix is used to examine multicollinearity problems between independent variables. As this paper's two regression models have different

independent variables, two correlation matrix need to be investigated. These are as below:

Table-1: Correlation Matrix 1

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Tier-1 + Tier-2 Capital	1					
(2) Tier-1 Capital	0.9968	1				
(3) NPL	-0.3578	-0.3584	1			
(4) Liquidity	-0.0036	0.0096	0.0049	1		
(5) GDP Growth Rate	-0.006	-0.0066	-0.005	0.0123	1	
(6) Inflation Rate	0.0026	0.028	-0.0209	0.157	-0.2837	1

The correlation matrix for the independent variables in the first model is shown in Table 1. As expected, a strong correlation is observed between Tier-1 capital and the combined Tier-1 + Tier-2 capital, since the latter includes the former. Despite this, both variables are treated separately in the analysis, and no multicollinearity concerns arise. Similarly, Table 2 displays the correlation matrix for the second model, which also includes five variables. The results are consistent with those of Model 1, confirming the absence of multicollinearity issues.

Table-2: Correlation Matrix 2

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Tier-1 + Tier-2 Capital	1					
(2) Tier-1 Capital	0.9969	1				
(3) Lending	-0.0539	-0.0595	1			
(4) NPL	-0.3455	-0.343	-0.0114	1		
(5) GDP Growth Rate	-0.0157	-0.0169	0.0355	0.0298	1	
(6) Inflation Rate	0.0482	0.0752	-0.0521	-0.0271	-0.2867	1

3.4 Stationary Test: Panel Unit Root Test

For the panel data of this study, the Unit Root test of Levin-Lin-Chu is operated to test stationarity. The null hypothesis of this test refers to the data containing a root which is not stationary, and the alternative hypothesis is that the data is stationary. Here, the p-value of the unit root test is lower than 1%. Hence, the null hypothesis is rejected, suggesting the variables used in this paper are stationary.

Table-3: Panel Unit Root Test

Test	Hypothesis	Lending	Capital (Tier-1 + Tier-2)	Capital (Tier-1)	NPL	Liquidity	GDP Growth Rate	Inflation Rate	ROA	Industry Avg. CAR
Levin-Lin-Chu, *t*	Ho: Panels Contain Unit Roots	p***	p***	p***	p***	p***	p***	p***	p***	p***

*** p<0.01, ** p<0.05, * p<0.1

3.5 Descriptive Statistics

Descriptive statistics of this study are given below:

Table-4: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Tier-1 + Tier-2 Capital	327	0.094806	0.22301	-1.37412	0.804589
Tier-1 Capital	327	0.061935	0.22045	-1.37576	0.794201
NPL (Lag)	324	0.071857	0.125697	0	0.829233
Liquidity (Lag)	324	0.123749	0.06228	0.007268	0.681395
ROA	327	0.007723	0.008996	-0.0702	0.0275
Lending	327	0.701366	0.238476	0.346646	4.732292
NPL (Current)	327	0.073785	0.128212	0	0.829233
GDP Growth Rate	330	0.06599	0.012276	0.0351	0.0815
Inflation Rate	330	0.0605	0.006642	0.0551	0.0753

Table 4 shows that the number of observations for Capital (Tier-1 + Tier-2) and Capital (Tier-1) are 327, as three banks were established in 2013. The average CAR is 9.48%, which is lower than Basel III (from 2019 to 2021) or even Basel II. The rate is lower because of the negative CAR of some banks. Though banks should maintain at least 12.5% capital against risk-weighted assets, eight banks failed to maintain it in 2021. The minimum CAR is -137.4% for ICB Islami Bank. For this bank, the CAR is negative for all the years from 2012 to 2021. The maximum CAR was 80.46% for NRBC bank in 2013, as the capital ratio was higher at the time of establishment. The minimum Tier-1 capital should be 6.0% and the mean value is 6.19%, slightly greater than the minimum condition. Tier-1 capital ranges from a minimum of -137.6% to a maximum of 79.42%.

The number of observations is 327 for NPL (current) and 324 for NPL (lag). The average NPL is 7.39%, which is lower than the industry average, as the NPL is greater for some state-owned banks that are not listed in DSE. The minimum NPL is 0, and the maximum NPL is 82.92%, which is also for ICB Islami Bank. The average liquidity ratio is 12.37%, which is lower than the demand. The minimum liquidity was only 0.73% in Uttara Bank in 2012. The average ROA is only 0.77%. The maximum ROA was 2.75% for Social Islami Bank in 2012. On average, the lending to total asset ratio is 70.14%. The average GDP growth rate is 6.6%, but it was only 3.51% in 2020 because of the impact of the pandemic on the economy. The average inflation rate is 6.05%, and the maximum inflation was 7.53% in 2013.

Figure-1: Industry Average CAR

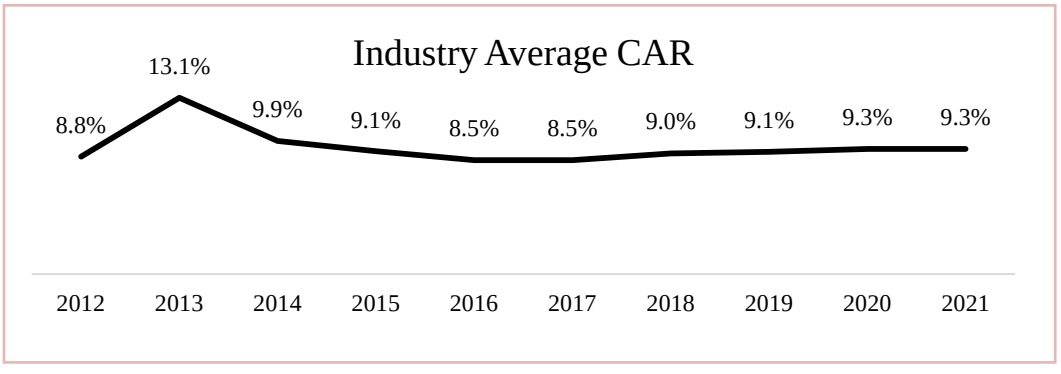


Figure-2: Industry Average Lending to Asset Ratio

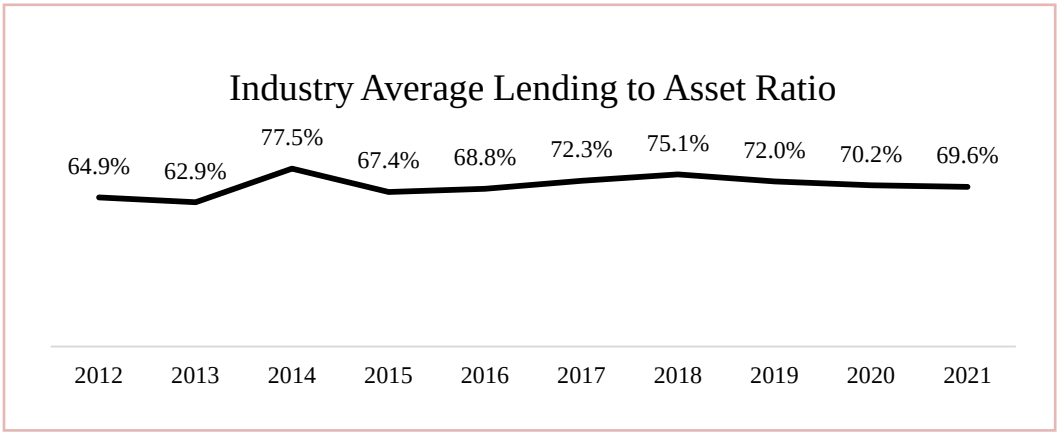
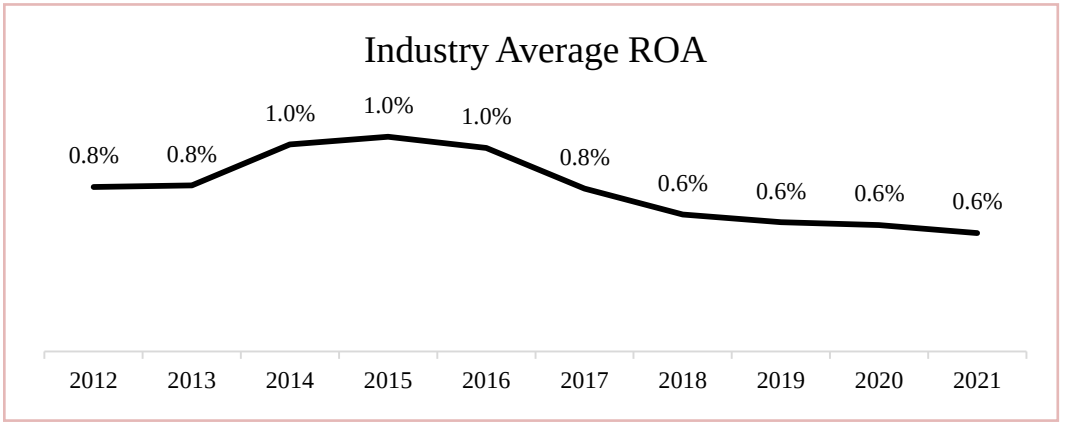


Figure-3: Industry Average ROA



4.0 Empirical Framework

The regression models of this paper are presented below:

$$Lending_i = a_i + b_1 Capital_{it} + b_2 NPL_{i\,t-1} + b_3 Liquidity_{i\,t-1} + b_4 GDP\ Growth\ Rate_{it} + b_5 Inflation_{it} + \varepsilon \ldots (i)$$

$$Profitability_i = a_i + b_1 Capital_{it} + b_2 Lending_{it} + b_3 NPL_{it} + b_4 GDP\ Growth\ Rate_{it} + b_5 Inflation_{it} + \varepsilon \ldots (ii)$$

*i is firm here.

Equation (i) models bank lending as the dependent variable and bank capital as the independent variable. Firm-level control variables are NPL and bank liquidity. In equation (ii), profitability is the dependent variable. Capital is the concern independent variable; firm-level control variables are lending and NPL. Both models include GDP growth rate and inflation as macroeconomic control variables. These two types of control variables are selected based on previous studies by Karmakar and Mok (2015). Since this study uses panel data, appropriate panel data models, such as the Random Effect and Fixed Effect Model, are employed. To address issues of multicollinearity and autocorrelation, the FGLS model is applied. Additionally, a Year Fixed Effect Model is used to control for year-specific effects. Finally, to address potential endogeneity concerns, the Instrumental Variable (IV) approach is implemented. Detailed measurements of the variables are discussed below:

(i) Lending: Here, lending is the ratio of the loan to total assets at time t. The loan includes the entire loan, advances, bills purchased and discounted. Loans provided to all the sectors are included here. The following equation is employed to derive the ratio.

$$\text{Lending} = \frac{Loans, advances, bill\ purchased\ \&\ discounted}{Total\ assets}$$

Here, one important clarification is that banks conducting business as per Islamic Shariah do not mention loans; instead, they mention investments. This investment is considered here as lending.

(ii) Profitability: Return on Assets (ROA) serves as the metric for assessing bank profitability in this study. It represents the ratio of net profit after tax to the average total assets. The calculation is based on the formula shown below.

$$ROA = \frac{Net\ profit}{Average\ total\ assets}$$

(iii) Capital: The Capital Adequacy Ratio (CAR) is widely regarded as the most effective measure of capital in the banking sector. This study considers both Tier-1 and Tier-2 capital. In the first scenario, capital is defined as the combined total of Tier-1 and Tier-2 capital, while in the second scenario, only Tier-1 capital is used, as it represents the bank's core capital. To assess capital adequacy, risk-weighted assets serve as the basis. The calculation is based on the formula shown below:

$$Capital = \frac{Tier-1 + Tier-2}{Risk\ weighted\ assets}$$

$$Capital = \frac{Tier-1}{Risk\ weighted\ assets}$$

(iv) NPL: One of the firm-specific control variables used here is the non-performing loan. This is used in both models, using a 1-year lag in the first model and a contemporaneous value in the 2nd model. The argument for using lag NPL in the first model is that if last year's NPL is higher, it is highly likely that the bank has lower funds available to provide the loan. So, lag NPL negatively affects banks' lending.

The presence of non-performing loans (NPLs) adversely affects a bank's profitability. For higher NPL, banks need to make more provisions, which reduces

their profitability. NPL is the classified loan which consists of 3 things: Sub-standard, Doubtful, Bad and loss. The ratio of the non-performing or classified loans to total loans is used to measure NPL, as below:

$$NPL = \frac{Non-performing\ loans}{Total\ loans}$$

(v) Liquidity: Liquidity is the firm-specific control variable. The ratio of the liquid assets to total assets is considered in measuring liquidity. Here, this variable is lagged for 1 year. The concept is that if any bank has adequate liquid assets at the end of the last year, it can provide more loans for the current year. Liquid assets consist of cash, money at call and on short notice, and balances with other banks and financial institutions. To determine the ratio, the formula below is applied:

Liquidity $_{t-1}$ = (Cash $_{t-1}$ + Money at call and on short notice $_{t-1}$ + Balance with other banks and financial institutions $_{t-1}$) / (Total assets $_{t-1}$)

(vi) GDP growth rate: This is the macro control variable. This is the secondary data taken directly from the World Bank Data Bank for Bangladesh. This is the percentage growth in Bangladesh's gross domestic product.

(vii) Inflation: This is another macro control variable. This secondary data is taken directly from the World Bank Data Bank for Bangladesh. This is the percentage of inflation that was experienced in Bangladesh.

Drawing on existing literature and theoretical frameworks, the anticipated effects of the independent variables are as follows:

Table-5: Expected Outcome

Variables	Expected Effect on Lending	Expected Effect on Profitability
Capital	(+)	(+)
NPL	(-)	(-)
Liquidity	(+)	
GDP Growth Rate	(+)	(+)
Inflation	(-)	(+) / (-)
Lending		(+)

5.0 Results

5.1 Effect of Bank Capital (Tier-1 + Tier-2) on Lending: OLS, Random Effect and Fixed Effect

Table 6 presents the findings on how bank capital influences lending, with capital measured as the sum of Tier-1 and Tier-2 capital. The results are shown here, representing the outcomes from Ordinary Least Squares (OLS), Random Effects (RE), and Fixed Effects (FE) models.

Table-6: Effect of Bank Capital on Lending (OLS, RE, FE)

	OLS	RE	FE
VARIABLES	Lending (1)	Lending (2)	Lending (3)
Capital (Tier-1+Tier2)	-0.533***	-0.482**	-0.100
	(0.150)	(0.188)	(0.113)
NPL	-0.912***	-0.822**	0.040
	(0.276)	(0.343)	(0.113)
Liquidity	-0.276*	-0.291**	-0.402*
	(0.166)	(0.134)	(0.200)
GDP Growth Rate	0.395	0.415**	0.597***
	(0.356)	(0.187)	(0.152)
Inflation Rate	-0.635	-0.571	0.123
	(3.000)	(2.833)	(3.074)
Constant	0.864***	0.850***	0.713***
	(0.131)	(0.126)	(0.151)
Observations	324	324	324
Number of banks	33	33	33
R-squared	0.027	0.026	0.012

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Here, the number of observations is 324, and the value of the F-test of the OLS model is 11.73. The model is statistically significant with a p-value below 1%.

However, the R-squared value is 2.7%, indicating that the independent variables explain only a small portion of the variability in the dependent variable. The constant value indicates that if the entire coefficient is 0, the lending amount is 86.4% of total assets. The coefficient of capital is -0.533, indicating that if capital is increased by 1%, the lending is likely reduced by 0.53%, keeping other things held constant and vice versa. This is statistically significant at 1% level of significance. The result found here is the opposite of the expectation. There may be various reasons for this opposite result. Primarily, this can be attributed to the lower number of observations. Second, the amount of lending is highly affected by the credit demand in the economy. Hence, capital cannot be affected positively here. Another reason can be the lower amount of capital of many banks. Though banks should have to maintain at least 12.5% CAR, which is the measurement of capital, out of the 33 banks, 8 banks failed to maintain it in 2021.

The coefficient value of NPL is -0.912. It means keeping other things held constant if the previous year's NPL is increased by 1%; the current year lending is decreased by 0.91% and vice versa, which is similar to the previous literature. This is statistically significant at 1% level of significance. In the case of liquidity, the opposite result of the previous literature is found. Last year, liquidity conditions negatively affected the current year's lending, which is statistically significant at a 10% significance level. In the case of GDP, the positive result is found. When GDP is increased by 1%, lending is also increased by 0.4% and vice versa, keeping other things constant. However, this is not statistically significant. An increase in inflation also reduces the amount of lending to banks, but the result found here is not statistically significant. These two outcomes of macroeconomic control variables gave similar results to previous literature.

Random Effect (RE) and Fixed Effect (FE) models are also presented here for more robust results. Based on the Hausman Test, the RE model is preferred here. The appendix presents the result of the Hausman Test. The probability value of the RE Wald Chi-square is statistically significant, indicating that the model is valid. Based on the RE, the coefficient is also negative. If the capital is increased by 1%, lending is decreased, likely by 0.48%, keeping other things constant and vice versa. At the 5% level of significance, the result is statistically significant and aligns with the OLS result. Hence, the results of my study indicate that bank capital of the listed commercial banks of Bangladesh has a statistically significant negative effect on lending.

5.2 Effect of Bank Capital (Tier-1 + Tier-2) on Lending: FGLS (With and Without Year Fixed Effect)

For additional robustness, a Feasible Generalized Least Squares (FGLS) model is also employed. The FGLS results indicate homoscedasticity and show no evidence of autocorrelation within the dataset. This study evaluates the impact of bank capital using the FGLS model in two ways: (i) including year fixed effects, and (ii) excluding them. Given that the economy was adversely impacted by the recent COVID-19 pandemic, incorporating year fixed effects helps capture the influence of time-specific factors.

Table-7: Effect of Bank Capital on Lending (FGLS)

	Without Year Fixed Effect	With Year Fixed Effect
Variables	Lending (1)	Lending (2)
Capital (Tier-1+Tier2)	-0.533**	-0.623***
	(0.209)	(0.210)
NPL	-0.912**	-1.070***
	(0.362)	(0.365)
Liquidity	-0.276	-0.336
	(0.212)	(0.213)
GDP Growth Rate	0.395	-1.004
	(1.101)	(1.558)
Inflation Rate	-0.635	-10.011
	(2.112)	(8.385)
Constant	0.864***	1.489***
	(0.172)	(0.489)
Observations	324	324
Number of banks	33	33

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In column (1) of Table 6, the coefficient value of capital in the FGLS model (Without year fixed effect) is -0.533, the same as the OLS model. Keeping other things fixed, if capital is increased by 1%, lending is likely to decrease by 0.53% and vice versa. At the 5% significance level, the result is statistically significant and agrees with the OLS model. Under the year fixed effect FGLS model, the capital coefficient is -0.623, suggesting that capital negatively impacts bank lending, with this finding also statistically significant. This negative relationship is consistent with the OLS results.

The results of all the models presented here are consistent. This study found that the capital of the bank is negatively affected by the bank's lending, and this is statistically significant. Some possible reasons for the opposite result are:

1. The number of observations is lower
2. Lower capital adequacy ratio for banks
3. Lending is more affected by the economic credit demand, etc.

5.3 Effect of Bank Capital (Tier-1) on Lending

Table 8 presents the results of the investigation into whether the core capital affected the lending behavior of the bank. As the quality of Tier-2 capital is lower, only Tier-1 capital is considered the measurement of bank capital.

Table-8: Effect of Bank Capital on Lending (Tier-1)

	OLS	RE	FE	FGLS	FGLS (Year Fixed Effect)
VARIABLES	Lending (1)	Lending (2)	Lending (3)	Lending (4)	Lending (5)
Capital (Tier-1)	-0.587***	-0.539***	-0.083	-0.587***	-0.639***
	(0.165)	(0.200)	(0.069)	(0.212)	(0.211)
NPL	-0.987***	-0.902**	0.052	-0.987***	-1.080***
	(0.297)	(0.357)	(0.113)	(0.363)	(0.362)
Liquidity	-0.257	-0.273**	-0.404*	-0.257	-0.320
	(0.160)	(0.139)	(0.206)	(0.212)	(0.213)

GDP Growth Rate	0.448	0.462**	0.612***	0.448	-0.852
	(0.354)	(0.189)	(0.154)	(1.099)	(1.552)
Inflation Rate	-0.172	-0.148	0.211	-0.172	-8.436
	(3.092)	(2.923)	(3.133)	(2.102)	(8.330)
Constant	0.821***	0.812***	0.702***	0.821***	1.367***
	(0.138)	(0.130)	(0.164)	(0.166)	(0.481)
Observations	324	324	324	324	324
R-squared	0.030		0.011		
Number of banks	33	33	33	33	33

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Based on the slope of each model, capital, which is measured by Tier-1 capital here, negatively affects bank lending. The results are statistically significant at 1% level of significance, except FE model. Based on the Hausman Test result, the RE effect model is consistent. This table also presents the year fixed effect. The coefficient value is negative, and this is consistent under OLS, RE, FGLS, and FGLS with year fixed effect. When capital is measured by only Tier-1 capital, it is similar to the impact of capital on lending measured by both Tier-1 and Tier-2 capital. In both measures, bank capital negatively affects the lending of banks operating in Bangladesh.

5.4 Effect of Bank Capital (Tier-1 + Tier-2) on Profitability: OLS, Random Effect and Fixed Effect

This section investigates the effect of bank capital on profitability. Capital is measured in two ways in this paper. First, Table 9 presents the results where capital is measured by both Tier-1 and Tier-2 capital using OLS, RE, and FE models.

Table-9: Effect of Bank Capital on Profitability (OLS, RE, FE)

	OLS	RE	FE
VARIABLES	ROA (1)	ROA (2)	ROA (3)
Capital (Tier-1+Tier-2)	-0.007*	-0.011	-0.028***
	(0.004)	(0.008)	(0.004)
Lending	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
NPL	-0.068***	-0.070***	-0.013
	(0.007)	(0.017)	(0.020)
GDP Growth Rate	0.036	0.036**	0.021
	(0.025)	(0.016)	(0.021)
Inflation Rate	0.102**	0.108**	0.159***
	(0.046)	(0.052)	(0.043)
Constant	0.006	0.006	0.001
	(0.004)	(0.004)	(0.002)
Observations	327	327	327
R-squared	0.659		0.138
Number of banks	33	33	33

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Here, profitability is measured by ROA. In Table 8, column (1) represents the findings of bank capital's effect on profitability under the OLS The overall model is significant based on the P-value of the F test. The R-squared value is 0.659, indicating that about 65.9 of % variation in the dependent variable can be explained by the combined variation in the independent variables. The constant is 0.006, indicating that if all the coefficients are zero, the ROA would be 0.006%. This segment measures capital by Tier-1 and Tier-2. Keeping all the things held constant, the coefficient indicates that if capital is increased by 1%, ROA is likely to decrease by 0.007% and vice versa. This is significant at the 10% threshold. This is also the opposite of the expectation, like lending. Lower number of observations and lower amount of capital ratio are the possible reasons for this opposite result.

In this analysis, neither lending nor GDP growth rate shows statistical significance. However, the negative coefficient of non-performing loans (NPL) is significant at

the 1% level. Controlling for other factors, 1% increase in NPL is associated with a 0.068% decrease in ROA, and vice versa. Additionally, inflation has a positive and statistically significant impact on banks' ROA. Overall, the results for the control variables align with existing literature, except for inflation.

Based on the Hausman test's Chi-square value, FE is consistent. The coefficient of the capital, which contains both Tier-1 and Tier-2 capital, is also negative and statistically significant. Holding other things fixed, if capital is increased by 1%, ROA is likely to decrease by 0.03% and vice versa. The result contradicts the expectation. However, the result is consistent with OLS.

5.5 Effect of Bank Capital (Tier-1 + Tier-2) on Profitability: FGLS (With and Without Year Fixed Effect)

For further robustness checks, the FGLS regression model is applied here to examine the impact of bank capital on profitability. Both the year fixed effect and without year fixed effect without are presented in Table 10. Year fixed effect helps to control for any effect on the economy in a particular year.

Table-10: Effect of Bank Capital on Profitability (FGLS)

	Without Year Fixed Effect	**With Year Fixed Effect**
VARIABLES	ROA (1)	ROA (2)
Capital (Tier-1+Tier-2)	-0.007*	-0.005
	(0.004)	(0.004)
Lending	-0.001	-0.001
	(0.001)	(0.001)
NPL	-0.068***	-0.065***
	(0.007)	(0.007)
GDP Growth Rate	0.036	0.010
	(0.025)	(0.034)
Inflation Rate	0.102**	0.276
	(0.046)	(0.184)
Constant	0.006	-0.004
	(0.004)	(0.011)
Observations	327	327
Number of banks	33	33

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The slope of capital (Tier-1 + Tier-2) under FGLS without fixing year implies that if capital is increased by 1%, ROA is likely to increase by 0.007%, holding other things constant and vice versa. The negative relationship is significant at the 10% significance level. When the year fixed effect is applied, the coefficient also gives a negative result. When capital is increased by 1%, ROA is likely to increase by 0.005% and vice versa, keeping other things held constant. However, this is not statistically significant. But the findings of FGLS are consistent with other models that capital negatively affects profitability, which is opposite to our expectation.

5.6 Effect of Bank Capital (Tier-1) on Profitability

Here, capital is measured by only Tier-1 capital. The following table represents the results of the different methods.

Table-11: Effect of Bank Capital on Profitability (Tier-1)

	OLS	RE	FE	FGLS	FGLS (Year Fixed Effect)
Capital (Tier-1)	-0.004	-0.007	-0.026***	-0.004	-0.003
	(0.006)	(0.009)	(0.005)	(0.004)	(0.004)
Lending	-0.001*	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
NPL	-0.062***	-0.065***	-0.011	-0.062***	-0.061***
	(0.014)	(0.017)	(0.020)	(0.007)	(0.007)
GDP Growth Rate	0.035*	0.036**	0.024	0.035	0.011
	(0.019)	(0.016)	(0.020)	(0.025)	(0.034)
Inflation Rate	0.102**	0.112**	0.183***	0.102**	0.288
	(0.042)	(0.053)	(0.047)	(0.046)	(0.185)
Constant	0.005	0.004	-0.002	0.005	-0.005
	(0.003)	(0.004)	(0.003)	(0.004)	(0.011)
Observations	327	327	327	327	327
R-squared	0.657		0.118		
Number of banks	33	33	33	33	33

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The Hausman test result indicates that FE is acceptable for RE and FE. The coefficient of the FE model indicates that capital negatively affects banks' profitability, which is statistically significant at 1% significance level. The coefficient of capital under OLS, FGLS, and FGLS (Year Fixed Effect) is also negative. However, this is not statistically significant under these three methods. The findings where capital is calculated by only Tier-1 capital are negative, similar to the findings of both Tier-1 and Tier-2 capital.

A negative relationship exists between profitability and bank capital, which is suggested by various researchers, such as Boyd and Runkle (1993), Naceur (2003), Micco et al. (2007), and Francis M. (2013). This study also finds a negative relationship based on the data of the banks in Sub-Saharan Africa. Some possible reasons for this negative result are given below:

1. The number of observations is lower
2. Lower capital adequacy ratio for banks
3. Higher non-performing loan affects profitability, liquidity, etc.

5.7 The Effect of Bank Capital on Lending and Profitability: IV Approach

To deal endogeneity issue, the Instrumental Variable (IV) approach is applied in this paper. Here, the main independent variable is capital, and there is a possibility of reverse causality, which is that capital can also be affected when lending is high. When a bank is profitable, it can also try to expand its business, and for expansion, deposits and capital are used. A study conducted by Karmakar and Mok (2015) also considered this endogeneity issue. The paper employs the average capital adequacy ratio of all banks as an instrumental variable, instrumenting capital defined as the sum of Tier-1 and Tier-2 capital. For calculating the industry average CAR, a total of 33 banks are divided into two segments: conventional banks (24 banks) and non-conventional or shariah-based banks (9 banks). The regression model used here is given below:

$$\text{Lending}_{i} = \alpha_i + b_1\widehat{\text{Capital}}_{it} + b_2\text{NPL}_{i\,t-1} + b_3\text{Liquidity}_{i\,t-1} + b_4\text{GDP Growth Rate}_{it} + b_5\text{Inflation}_{it} + \varepsilon$$

$$\text{Profitability}_{i} = \alpha_i + b_1\widehat{\text{Capital}}_{it} + b_2\text{Lending}_{it} + b_3\text{NPL}_{it} + b_4\text{GDP Growth Rate}_{it} + b_5\text{Inflation}_{it} + \varepsilon$$

When lending is the dependent variable, the Cragg-Donald Wald F-statistic is 45.152. In contrast, when ROA is the dependent variable, the Cragg-Donald Wald F-statistic

is 25.853. So, the instrument is valid. It directly affects the individual bank's CAR but does not affect the individual bank's lending or profitability. When capital is increased by 1%, lending is likely to decrease by 1.33% and vice versa. This result, significant at the 5% level, is in line with those from other models discussed earlier.

Moreover, the analysis indicates that a 1% increase in capital leads to a 0.032% reduction in ROA, with the relationship being statistically significant at the 10% level. This finding is in line with the results obtained from the other models examined in this research.

Table-12: Effect of Bank Capital on Lending and Profitability

VARIABLES	**Lending (1)**	**VARIABLES**	**ROA (2)**
Capital (Tier-1+Tier-2)	-1.326**	Capital (Tier-1+Tier-2)	-0.032*
	(0.604)		(0.017)
NPL	-2.230**	Lending	0.001
	(1.011)		(0.002)
Liquidity	-0.263	NPL	-0.003
	(0.217)		(0.028)
GDP Growth Rate	0.151	GDP Growth Rate	0.020
	(1.139)		(0.029)
Inflation Rate	-1.246	Inflation Rate	0.068
	(2.202)		(0.054)
Constant	1.082***	Constant	-0.001
	(0.235)		(0.005)
Observations	324	Observations	324
R-squared	-0.017	R-squared	0.563
Cragg-Donald Wald F-statistics	45.152	Cragg-Donald Wald F-statistics	25.853

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.0 Conclusion

This research explores the impact of bank capital on lending and profitability. Unlike much of the existing literature, which tends to analyse these effects in isolation, this

study addresses both aspects concurrently, specifically focusing on listed commercial banks in Bangladesh.

Though capital is expected to positively affect lending and profitability of the banks, this paper finds a negative relationship between them. These results are statistically significant. There are various potential reasons for these opposite results. A lower number of observations can be a possible reason for this negative outcome. Another reason is the lower capital of banks. From the regulatory perspective, many banks failed to maintain the directives of the regulator. Banks should maintain at least 12.5% CAR in 2019, but many banks failed to do so. Several banks are facing a capital shortfall in Bangladesh. This can be the possible reason for the negative outcome. Another reason can be that the credit demand in the economy may influence lending, but this is not considered here. In sum, this paper finds a statistically significant negative relationship between capital and lending as well as capital and profitability in Bangladesh.

Several targeted policy actions are necessary, given the findings of a negative relationship between bank capital and both lending and profitability in the context of Bangladeshi commercial banks. To improve the financial stability and performance of banks in Bangladesh, regulatory authorities such as the Bangladesh Bank should rigorously enforce minimum capital requirements and take corrective actions against non-compliant institutions through proactive supervision and timely intervention. At the same time, it is essential to enhance internal governance and risk management frameworks within banks to ensure more effective capital utilization and to prevent practices that could lead to capital erosion. Additionally, banks should be encouraged—through regulatory incentives or policy support—to strengthen their capital base via equity issuance, retained earnings, or mergers with more stable institutions, thereby improving their resilience and capacity to sustain credit growth.

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Appendix

Hausman test: Capital and Lending (Both Tier-1 and Tier-2 capital)

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
capitaltie~2	-.1000716	-.4822682	.3821967	.2712779
npl	.0398826	-.8215826	.8614651	.3875538
liquidity	-.4022093	-.2908892	-.1113201	.1337869
gdpgrowthr~e	.5970884	.4152565	.1818319	.
inflationr~e	.1226964	-.5705356	.693232	.3561023

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 6.72
Prob>chi2 = 0.2424
(V_b-V_B is not positive definite)

Hausman test: Capital and Lending (Tier-1 capital)

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
capitaltier1	-.0830212	-.5386054	.4555843	.3190449
npl	.0519848	-.9023789	.9543636	.3986335
liquidity	-.4041703	-.2729733	-.131197	.1364903
gdpgrowthr~e	.6115362	.46223	.1493062	.
inflationr~e	.2107949	-.1477297	.3585247	.4314716

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 7.34
Prob>chi2 = 0.1969
(V_b-V_B is not positive definite)

Hausman test: Capital and Profitability (Both Tier-1 and Tier-2 capital)

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
capitaltie~2	-.0275385	-.0105543	-.0169843	.0015897
totalloant~s	-.0007814	-.0009742	.0001928	.
nplcurrent	-.0130182	-.0704073	.0573891	.0078724
gdpgrowthr~e	.0213111	.0363246	-.0150135	.
inflationr~e	.1591443	.1075865	.0515578	.

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= -29.83 chi2<0 ==> model fitted on these data fails to meet the asymptotic assumptions of the Hausman test; see suest for a generalized test

Hausman test: Capital and Profitability (Tier-1 capital)

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
capitaltier1	-.0263091	-.0073722	-.0189368	.0020989
totalloant~s	-.0007102	-.000854	.0001438	.
nplcurrent	-.0113775	-.0653124	.0539348	.0079917
gdpgrowthr~e	.0242773	.0360575	-.0117802	.
inflationr~e	.1828618	.1116442	.0712175	.

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 78.05
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)