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CAPITAL ADEQUACY AND CREDIT RISK IN BANKING: THE MODERATING ROLE OF REVENUE DIVERSIFICATION

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Abstract: Capital regulatory requirements are one of the prominent mechanisms to control bank credit risk-taking behavior and subsequently achieve financial stability. The study aimed to evaluate the moderating role of revenue diversification in the relationship between capital adequacy and credit risk behavior of 102 listed South Asian banks. We collected data from DataStream covering the period from 2011 to 2022. The study employed a fixed effect panel data model, system GMM, a two-step system dynamic panel estimation technique, and the Sargan test to analyze study results, resolve potential endogeneity problems, effectively use short time period and long cross-section dataset, and achieve instrument validity, respectively. We conclude that South Asian banks face low levels of credit risk and the

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interaction of revenue diversification with the capital adequacy ratio significantly and negatively reduces credit risk. The findings implicate little adverse selection problem among South Asian banks and the need for expanding non-traditional income sources while fulfilling regulatory capital requirements.

Keywords: Capital adequacy; credit risk; revenue diversification; fixed effect model; GMM; South Asian banks.

JEL Codes: G20, G21, G32.

1. Introduction

Over the past years, different theoretical aspects and actions have been proposed to minimize the degree of various bank risks while maintaining effective regulation (Borio & Zhu, 2012). One of these principles is the implementation of capital adequacy requirements. Following widespread implementation, its efficacy in lowering bank risk-taking behaviors has gained significant attention. The risk-taking practices of banks in some emerging countries have drawn significant attention following the failure of global banking organizations and other financial institutions (Nguyen et al., 2021). However, excessive risk-taking and lack of effective and adequate control of the regulatory system have contributed to the recent financial distress in financial firms (Kayed & Hassan, 2011). The effectiveness of regulatory capital strategy in reducing bank risk-taking behaviors has drawn a lot of attention, particularly because of the 2008 financial crisis.

The fact that many institutions made hazardous investments while having insufficient capital buffers during this crisis. Consequently, the issues of how capital regulations affect risk-taking behavior and outcomes have drawn the attention of researchers in this area. As per Jumreornvong et al. (2018), capital regulation relates to the capital amount that a bank is required to maintain to fulfill regulatory requirements. Further, regulatory capital contains Tier I and Tier II capitals. Commercial banks are required to keep minimum capital equivalent to 8% of their risk-weighted assets (Ashraf et al., 2016). Basel I Accord was presented in 1988 to formally introduce capital requirements for banks. However, Basel II was formed to overcome the issues faced in Basel I to make effective changes in risk-based capital requirements. The inherent flaws in the Basel II capital requirements are made clear by the global financial crisis (GFC) of 2008. Because of the interconnectivity of businesses worldwide, the GFC resulted in a severe blow to all industries, including the banking industry. As a result, the Basel III Accord was proposed with the main goal of highlighting the pertinent issues of minimum capital requirements and banks' excessive leverage (Obadire et al., 2022). According to the arguments of Macey and

O'Hara (2003), insolvency risk is a significant issue in the banking industry because of the high amount of debt banks take and more susceptible of becoming insolvent. In addition, a single bank failure might hurt the entire financial system (Calluzzo & Dong, 2015). The fact of this failure is that bank operations spread through the network of interbank liabilities due to the interbank connectedness of the global banking system. Therefore, it has become important to establish such regulations which might be crucial for bank stability. Capital regulatory requirements are one of the prominent mechanisms helping banks to reduce economic costs during banking crises (Fullenkamp & Rochon, 2017), consequently maintaining their strong financial system.

Capital rules have a significant impact on how stable banks are. Ensuring banks have enough capital to absorb unanticipated losses and survive financial shocks is the core goal of capital requirements (Berger & Bouwman, 2013). The issue of shortage of capital in the banking industry raised concerns after the financial crisis of 2008. After the crisis, the debate started on how to reinforce bank stability. Therefore, the answer was to introduce new capital regulatory requirements to make the financial sector more stable (Ashraf et al., 2016). To improve in financial system of banks, the Basel Committee on Banking Supervision (BCBS) proposed to introduce Basel III to alter the capital regulations of banks (Tanda, 2015). The development of Basel III came in 2010 and increased the capital requirements of banks. The Basel III Accord contributed to managing risk and supervision by providing adequate capital requirements. When banks increase capital regulations, they face more risk in maintaining the cost of capital (Blum, 1999) and therefore, it is important to implement capital regulations effectively for the stability of banks.

On the contrary, imposing high levels of capital requirements may enhance the loss-absorbing ability of banks and overcome the pro-cyclicality of debt level, therefore supporting avoiding heavy financial crises (Admati & Hellwig, 2014). Financial and economic situations in the Asian developing countries vary across countries (Mehmood et al., 2024), therefore, the effective application and implementation of regulatory capital, corporate governance structure, and maintaining bank stability are vital for sustainable economic stability and growth in this region. Since the start of the financial crisis, regulators and policymakers have often voiced their criticism of financial firms for failing to keep enough capital reserves (Haq et al., 2014). Banks use capital requirements, which act as the cornerstone of prudential control, to allocate financial resources and implement risk management procedures. In addition, by using income diversification, banks may split their income sources for promoting various financial activities. Therefore, they minimize the risk and reduce their dependency on any one source of income in this way, which lessens the risk relating to that specific activity. Various revenue sources act as a buffer to control credit risk

(Shim, 2013), ultimately reducing the effects of low capital adequacy on bank credit risk.

Banks operating in developing countries are inclined to engage in alternate sources of revenue which is useful for improving financial stability and minimizing bank risk (Nguyen et al., 2012). However, banks may face challenges in managing non-interest sources of income. Further, banks can earn high returns by expanding their income sources, but they face greater risk as more funding is generated from non-deposits (Demirgüç-Kunt & Huizinga, 2010). Financial institutions may improve their ability to respond to credit risk events while maintaining an adequate amount of capital to assist their work by diversifying their revenue sources. By investigating the influence of bank diversification on valuation, Guerry and Wallmeier (2017) conclude that diversification is a significant factor in the valuation of banks. Therefore, banks are keen to increase the revenue sources beyond their traditional sources.

The financial crisis of 2008 may result in a lack of liquidity and a decline in the value of stock markets (Brunnermeier, 2009). According to a study by Abbas and Ali (2022), a financial crisis causes excessive risk for banks, which promotes them to engage in non-traditional income sources. Additionally, banks engaging in alternate revenue sources do not need to keep a high level of capital adequacy as high revenue diversification practices are advantageous for banks to minimize credit risk. For example, Stolz and Wedow (2011) argue that banks revealing lower income diversification face more challenges of credit risk, which forces banks to keep high values of capital buffer to overcome such risks. This suggests that banks with low-income diversification rely on limited income streams which increases more chances of default from borrowers. Considering this issue, regulators require banks to keep a high level of capital adequacy ratio helping banks to mitigate such risky practices. In addition, Shim (2013) describes that banks can decrease the value of capital they need by enhancing the proportion of non-traditional revenue sources, which in turn helps to mitigate their earnings volatility. Considering the pivotal significance of the income diversity of banks in influencing the association between capital adequacy and risk-taking, we include revenue diversification as a moderator in our research model.

Numerous empirical researches have indicated an interest in examining the relationship between regulatory capital and bank risk in emerging-market financial systems (Dwekat et al., 2020). For example, Haq et al. (2014) studied Asian-Pacific banks while Ashraf et al. (2016) investigated Pakistan banks. However, they provide mixed results. It is good to note that Velasco (2022) analyzes the mediating role of revenue diversification between capital adequacy and bank value in developed countries while no adequate study was conducted in a developing economy context.

It is no surprise that recently the association between capital requirements and bank risk has become a concern, mainly because the capital level may have an adverse or favorable impact on bank stability, therefore empirical findings in this field are mixed (Lee & Hsieh, 2013). Banks operating in emerging countries of South Asia follow capital buffer theory while keeping sufficient levels of capital to prevent credit risk (Hunjra et al., 2020). In developing countries including Pakistan, the capital market is also very sensitive and quickly reacts to uncertain events (Irshad et al., 2023), therefore, capital regulation is important to manage these uncertainties. The features and regulations in developing countries are different compared to the developed world (Haque & Shahid, 2016). Further, business and economic environments in developing countries are not the same as in developed countries (Mehmood et al., 2019). The banking industry is an important element of the South Asian economies providing a profitable and stable system which is needed for a financially strong economy (Nisar et al., 2018).

The ongoing study adds to the current body of knowledge by evaluating the influence of capital adequacy on the risk-taking behavior of banks operating in South Asian countries as this region has diverse economic and regulatory environments. Further, the study employs revenue diversification as a moderating factor between capital adequacy and bank risk-taking representing another valuable contribution to the present literature. This is the novel contribution of the study as it uncovers how revenue diversification influences bank risk given the importance of regulatory requirements. The study also provides country-wise analysis as each country has different economic and regulatory situations, therefore, this additional analysis provides deep insight into how capital adequacy and revenue diversification are important to manage credit risk. By using a sample of 102 South Asia banks (Pakistan, India, Sri Lanka, and Bangladesh), we employed static and dynamic models for analyzing the data. We find that the capital adequacy ratio significantly reduces credit risk. Further, the interaction of revenue diversification with capital adequacy further strengthens the negative relation.

The remaining part of the study is organized as follows: A literature review is provided in Section 2 that serves as a foundation to formulate hypotheses. Data and methodology are outlined in Section 3. Empirical results are discussed in Section 4, whereas a conclusion and policy implication is provided in Section 5.

2. Review of Literature

Banks employ strategies to mitigate risk for stability. Implementing capital adequacy requirements is an important factor for financial stability. The following section provides empirical evidence regarding the influence of capital adequacy on bank risk management. In addition, banks with more diversified income sources are less likely to face credit risk and the interaction of bank diversification with capital adequacy is useful for minimizing bank risk. Therefore, this section also explains the moderating role of bank diversification.

2.1 Impact of capital regulations on bank risk

One important metric for assessing a bank's financial steadiness and loss-absorbing capacity is the capital adequacy ratio. It is figured by dividing the capital of banks by their risk-weighted assets and is presented as a percentage (Xu et al., 2015). The purpose of the CAR is to guarantee that banks keep a sufficient amount of capital on hand to compensate for any losses that may result from their lending and investing operations. In the banking industry, capital regulation's primary goal is to keep owners and managers from taking unwarranted risks (Santomero, 1997). A bank's appetite for risk may rise as a result of the capital adequacy ratio (Zhang, et al., 2008). This argument suggests banks find it expensive to maintain larger capital ratios. Consequently, banks should take on greater risk to offset the expenses of maintaining higher capital ratios. There seems to be conflicting and inconsistent empirical data regarding the connection between regulatory capital and the risk-taking behavior of banks. Moreover, the agency theory proposed by Jensen and Meckling (1976) contends that risk-adjusted capital enhances the moral hazard problem by motivating owners to take on greater risk in their investments and by failing to control the incentives of banks.

The body of research on how capital requirements affect commercial banks' propensity for taking risks is currently somewhat fragmented. Higher capital requirements may force banks to take on greater risk, according to certain studies. In this context, various arguments provide that meeting regulatory capital requirements increases bank credit risk. Milne and Adler (1999) and Calem & Rob (1999) argue that when banks meet regulatory capital requirements, they bear more capital costs, and their risk-related activities are increased. As per De Andres and Vallelado (2008), bank regulatory requirements decrease the efficacy of other governance tools by applying limitations on ownership, or restricting operational activities which in turn increases risky activities. Strict capital requirements are likely to encourage banks to employ more risky investments and expensive equity modes of financing (Pasiouras et al., 2009; Hussain, Qalati, and Hussain, 2025). Banks with limited leverage ratios manage their assets portfolio by having more risky assets which ultimately increases the chances of default risk (Koehn & Santomero, 1980).

However, some arguments suggest that higher regulatory requirements lead banks to take less risk. For example, higher regulatory capital requirements can be a tool to mitigate the moral hazard problem connected with deposit insurance, leading to lower incentives for taking more risks (Keeley & Furlong, 1990). Similarly, Konishi and Yasuda (2004) conclude a negative impact of meeting capital requirements on bank risk-taking. Various arguments outline that higher levels of capital regulatory requirements reduce moral hazard problems caused by deposit insurance, thereby decreasing motivations for banks to engage in risky activities (Furlong & Keeley, 1989; Keeley & Furlong, 1990). Meeting regulatory capital requirements useful for banks to mitigate default risk as suggested by Mehran and Thakor (2011), and Chiaramonte and Casu (2017). In addition, Rachdi and Bouheni (2016) provide an argument that improved supervisory and regulatory practices result in reducing the risk-taking level in commercial banking. Banks meet regulatory capital requirements to give a signal to investors and depositors about financial soundness (Shim, 2013), which in turn decreases credit risk. Another study by Lee and Hsieh (2013) examines the role of capital adequacy on bank risk in Asian countries and concludes that banks meeting regulatory requirements have less risk. After reviewing the above studies, the present study proposes the following hypothesis.

Hypothesis 1: Capital regulation has a significant impact on credit risk

2.2 Moderating role of revenue diversification on capital regulation and bank risk

Both bank diversification and capital regulation have a significant influence on reducing default risk. However, implementing strict capital regulatory practices prevents banks from engaging in more risk-reducing activities such as income diversification (Velasco, 2022). This argument suggests that when a bank follows capital regulatory requirements more effectively and is involved in non-traditional sources of income, there are fewer chances of credit risk. Moreover, as per the argument provided by Shim (2013), less earnings volatility in more diversified banks minimizes the likelihood of bankruptcy and that bank diversification also lowers the amount of regulatory capital suggesting a negative relationship between diversified income sources and capital adequacy ratio. Therefore, we discuss in our study how the interrelationship of capital regulations and revenue diversification influences bank risk as both contribute to decreasing default risk. Banks can operate independently of capital regulations and set their own capital and risk-taking targets when they can maintain capital ratios that greatly surpass statutory restrictions (Ashraf et al., 2016). If banks diversify their sources of revenue outside usual banking services, they might become less dependent on traditional income streams. As per the argument of Stolz and Wedow (2011), banks with fewer revenue sources are expected to face credit risk, therefore they keep more level of capital adequacy to maintain financial stability. Banks may be less vulnerable to the detrimental effects of capital constraints on their bottom line as a result of their diversity. Revenue diversification may reduce the requirement of banks to keep high levels of capital ratios solely through interest sources of banking activities.

As per the portfolio theory of Markowitz (1952), revenue diversification may decrease risk exposure if non-interest income streams are not perfectly correlated with that of interest income sources resulting in maximizing bank returns. Therefore, diversification in various non-traditional income sources may help banks to enhance their performance. However, previous studies provide different arguments regarding how income diversification plays a role in influencing the relationship between capital adequacy ratio and bank risk-taking behavior. Abedifar et al. (2018) investigate the influence of non-traditional revenue sources on bank lending activities and find that banks with high non-interest revenue experience low credit risk. Chiorazzo et al. (2008) show that bank diversification can decrease risk, and as a result, financial distress is reduced. In addition, non-traditional revenue operations are beneficial for reducing the risk-taking behavior of banks in developing countries (Doumpos et al., 2016). Banks may reduce credit risk while engaging themselves in more non-interest sources of income along with traditional sources of income (Hunjra et al., 2021). Based on the above discussion, we formulate the following hypothesis.

Hypothesis 2: Revenue diversification has a moderating impact on capital regulation and credit risk

Existing past studies suggest that there is a lot of pertinent literature studying the association between capital adequacy requirements and bank risk-taking. However, researchers primarily focus in their studies on developed countries and single country, whereas developing countries are less studied with limited comparative analysis. Moreover, many studies have considered the association between capital adequacy and bank risk, whereas there is a lack of investigation relating to the interactive effect of revenue diversification. Therefore, analyzing the moderating effect of revenue diversification could provide a deep insight into how the management of banks can stabilize their operations while concentrating on capital adequacy. In past literature, there is a lack of comparative analysis of developing countries which offers another significant knowledge gap. This analysis may contribute to understanding the risk management practices and bank stability in South Asian banks. Therefore, the study also provides a significant contribution while incorporating the country-wise analysis showing how capital adequacy influences credit risk in each bank covering the moderating role of revenue diversification. Given the considerable literature gap, we believe that the current study adds a new insight into the extant literature.

3. Methodology and empirical data

We collected data from DataStream covering the period from 2011 to 2022 to investigate the moderating role of revenue diversification on capital adequacy ratio and bank risk-taking behavior in South Asian countries including Pakistan, India, Sri Lanka, and Bangladesh. Panel data of the present study consists of 27 banks from Pakistan, 31 banks from India, 21 banks from Sri Lanka, and 23 banks from Bangladesh for a time period of 2011 to 2022.

3.1 Measurement

We measured capital regulation by using two proxies. The first measure is capital to risk-weighted assets which is also referred to as risk-based capital ratio (Altunbas et al., 2007; Hunjra et al., 2020). Another measure of capital regulatory requirement is the capital adequacy ratio, which is expressed as risk-adjusted regulatory. To measure this proxy, we add Tier I and Tier II capitals and divide the sum by risk-weighted assets. These measures are also used by Demirguc-Kunt et al. (2013). We measure bank credit risk by using two proxies; non-performing loan (NPL) and Z-score. NPL is calculated as the proportion of NPL to gross loan amount as used by Adem (2023). The Z-score represents the financial position of banks concerning stability and bankruptcy (Hunjra et al., 2023). A high value of Z-score shows more stability with low bankruptcy. The value of the Z-score is calculated as the return of assets (ROA) plus equity to asset ratio (ETA) divided by the standard deviation of ROA as used by Hunjra et al. (2023). Further, following Liu et al. (2023), we measure a three-year rolling window for calculating the standard deviation of ROA. We follow Kim and Kim (2020) to measure the proxy of bank revenue diversification which is equal to the ratio of non-traditional sources of income to total income.

We use bank-level control variables such as bank size, deposit insurance, asset growth, and liquidity. As macroeconomic situations are important factors in understanding the risk-taking behavior of banks (Bui & Bui, 2020), we use three variables; interest rate, inflation rate, and GDP growth rate. Interest rate is a measure of interest on deposits (Nguyen et al., 2012). Following Rahman et al. (2020), inflation is calculated as a percentage change in the consumer price index, while GDP is the growth rate in GDP annually.

Table 1. Variable measures, abbreviation, and sources

Variables	Abbreviations	Measurement	Source/s
Capital adequacy ratio	CAR	Tier I capital plus Tier II capital and then divided by risk-weighted assets	Hunjra et al. (2020)

Capital to risk-weighted assets	CAP	Percentage of capital over risk-weighted assets of banks	Altunbas et al. (2007)
Z-score	ZSC	ROA + ETA/standard deviation of ROA	Hunjra et al. (2023)
Non-performing loan	NPL	Ratio of default loan to gross loan	Adem (2023)
Loan loss provision	LLP	Percentage of loan loss provision over gross loan	Naili and Lahrichi (2022)
Revenue diversification	RDV	Ratio of non-traditional income sources to total income	Williams (2016)
Deposit insurance	DINS	Dummy variable of value 1 if deposit insurance exists, otherwise 0	Fu et al. (2014)
Bank size	BSZ	Natural log of total assets	Pouraghajan et al. (2012), Boubaker et al. (2016), Hussain et al. (2022)
Assets growth	AGR	Percentage change in total assets annually	Constantinou et al. (2017)
Liquidity	LIQ	Liquid assets over total assets	Ashraf et al. (2016)
Interest	INT	Interest rate on deposits	Nguyen et al. (2012), Yüksel et al. (2018)
Inflation	INF	The change in consumer price index represented in percentage	Rahman et al. (2020)
GDP growth	GDP	Annual growth rate in GDP	Rahman et al. (2020)

We use a panel data statistical model for analyzing the data. The (N x T) dimensions are used as a measure for panel data observations. Further, N represents the number of sample banks and T shows the time period. Table 1 shows variable measures, abbreviations used, and their sources. The panel data model of our study is developed as follows.

$$y_{it} = \beta_0 + \beta_{it} X_{it} + u_{it} \; j = 1, \ldots, m(i); \; t = 1, \ldots, T, \; i = 1, \ldots, n \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Equation 1 shows the panel data model representing the sample size as the total number of banks in four countries, expressed as $\sum_{i=1}^{n} m(i)$, while $m(i)$ shows the total banks working in the ith country. Further, the total number of observations in our panel data is expressed as N = T x $\sum_{i=1}^{n} m(i)$, where T shows the time period from 2011 to 2022. However, y_{it} and u_{it} have dimensions of $N \, x \, 1$, while X represents $N \, x \, k$ matrix. In the above equation, β_0 is the intercept, and β represents a vector with the dimension of $k \, x \, 1$. In addition, X_{it} relates to the explanatory variables of the study. The panel data model highlights the unobserved individual variations across firms while using fixed or random effects. Considering this, $_{it}$ shows an error term which further is presented as the sum of αi and υ_{it}. Where, β_0 shows the intercept of each bank, while υit is the residual or error term. Considering this information, equation (1) above is represented as follows.

$$y_{it} = \beta_0 + \beta_{it} X_{it} + \alpha_i + \upsilon_{it} \quad \text{.......} \quad (2)$$

Equation (2) is formed on the following assumptions.

1) α_i and υ_{it} are jointly independent and have a normal distribution
2) $E(\alpha_i) = E(\upsilon_{ij}) = 0$,for i = 1, …. , m, j = 1, 2, …. , m(i)
3) $E(\alpha_j \alpha_{i,}) = \begin{cases} \sigma_{1'}^2 & i = i' \\ 0, & otherwise, \end{cases}$
4) $E(\upsilon_{ij} \, \upsilon_{i'j'}) = \begin{cases} \sigma_{2'}^2 & i = i', j = j' \\ 0, & otherwise, \end{cases}$

In a situation where unobserved effects and explanatory variables are correlated, a fixed effect model is preferred. However, when explanatory variables are proved to be random, then we use random effect mode. Taking into consideration the bank-related characteristics, the fixed effect model is suitable for this study. Further, the outcome of the Hausman test is also a reason for using the fixed effect model (Arianpoor & Asali, 2023). Equations (1) and (2) can be stated in the following way to analyze the effects of explanatory variables on credit risk.

$$CRR_{it} = \beta_0 + \beta_{it} X_{it} + \alpha_i + \upsilon_{it} \quad \text{.......} \quad (3)$$

Our independent variable is the capital adequacy ratio and the moderating variable is revenue diversification along with control variables including bank-related and country-specific variables. We employ three models in our analysis. Therefore, we further express equation (3) as under.

$$CRR_{i,t} = \alpha + \beta_1(CAR)_{i,t} + \beta_2(RDV)_{i,t} + \beta_3(DINS)_{i,t} + \beta_4(BSZ) + \beta_5(AGR) + \beta_6(LIQ) + \beta_7(INT)_{i,t} + \beta_8(INF)_{i,t} + \beta_9(GDP)_{i,t} + \mu_{i,t} \quad (4)$$

Whereas, CRR = bank credit risk which is the dependent variable, α = alpha, β = slope, while μ = error term. As we employ three models in our analysis, therefore, the above equation relates the Model 1 where we take CAR as the measure of capital adequacy, serving as an independent variable while keeping other variables the same.

$$CRR_{i,t} = \alpha + \beta_1(CAP)_{i,t} + \beta_2(RDV)_{i,t} + \beta_3(DINS)_{i,t} + \beta_4(BSZ) + \beta_5(AGR) + \beta_6(LIQ) + \beta_7(INT)_{i,t} + \beta_8(INF)_{i,t} + \beta_9(GDP)_{i,t} + \mu_{i,t} \quad (5)$$

In equation (5) above, we provide Model 2 of our analysis where we take CAP as another proxy of capital adequacy which treats as independent variable in the model.

$$CRR_{i,t} = \alpha + \beta_1(CAP)_{i,t} + \beta_2(CAP)_{i,t} + \beta_3(RDV)_{i,t} + \beta_4(DINS)_{i,t} + \beta_5(BSZ) + \beta_6(AGR) + \beta_7(LIQ) + \beta_8(INT)_{i,t} + \beta_9(INF)_{i,t} + \beta_{10}(GDP)_{i,t} + \mu_{i,t} \quad (6)$$

Where in equation (6), we present Model 3 of our analysis with the combined effect of both proxies of capital adequacy such as CAR and CAP. Additionally, we consider the moderating effects of bank revenue diversification on capital regulation and bank credit risk in the following models.

$$CRRi_{,t} = \alpha + \beta_1(CAR)_{i,t} + \beta_2(CAP)_{i,t} + \beta_3(RDV)_{i,t} + \beta_4(CAR)*(RDV)_{i,t} + \beta_5(CAP)*(RDV)_{i,t} + \beta_6(DINS)_{i,t} + \beta_7(BSZ) + \beta_8(AGR) + \beta_9(LIQ) + \beta_{10}(INT)_{i,t} + \beta_{11}(INF)_{i,t} + \beta_{12}(GDP)_{i,t} + \mu_{i,t} \quad (7)$$

Where (CAR)*(RDV) and (CAP)*(RDV) reveal the interaction terms of revenue diversification with both measures of capital adequacy.

4. Empirical results

Table 2 highlights a summary of data including mean, median, standard deviation, maximum and minimum values, and total observations.

Table 2. Summary statistics

Variables	Mean	Median	S.D	Maximum	Minimum	Obs.
CAR	0.215	0.172	0.437	0.913	0.068	1011
CAP	0.153	0.109	0.127	0.834	0.079	1011
NPL	0.086	0.082	0.144	0.792	0.093	1011

ZSC	4.139	4.035	0.352	7.262	0.276	1011
LLP	0.895	0.818	1.057	5.169	-0.251	1011
RDV	0.359	0.328	0.567	0.953	0.082	1011
BSZ	16.352	16.241	0.183	19.364	14.458	1011
DINS	0.762	0.7112	0.275	1	0	1011
AGR	0.216	0.207	0.462	2.413	-0.095	1011
LIQ	0.631	0.615	0.313	0.813	0.476	1011
INT	0.072	0.068	0.079	0.227	0.027	1011
INF	0.073	0.059	0.894	0.193	-0.013	1011
GDP	0.053	0.051	0.162	0.121	-0.023	1011

Source: Own processing

Outcomes indicate that banks operating in South Asian countries fulfill the minimum capital adequacy standard of eight percent as indicated by Ashraf et al., (2016). Furthermore, as per Basel II, the required level of capital requirement is eight percent. The average values of CAR imply that the banking sector in selected countries follows guidelines of Basel II capital requirements. The low minimum value of CAR signifies that few banks in this region are still unable to meet the required limit of capital adequacy. The mean value of CAR indicates that although banks maintain reasonable capital to finance their risk-weighted assets, however, they need to keep more amount of capital for grooming their financial health. The low average value of non-performing loans which is an indicator of credit risk, displays that banks in South Asian countries tend to bear less credit risk because first, they avoid generating more borrowers as well as they are more conscious of reducing the risk associated with borrowers and thus, exposed to a minimum adverse selection risk. Therefore, the banks effectively handle their debtors, and the chances of default are low. Similarly, the higher average value of the Z-score is an indication of low chances of financial distress which means banks avoid risk-taking in good financial position.

The third measure of the credit risk of our study is loan loss provision (LLP) with a high average value indicating that banks maintain a high level of provisions to pay potential losses from default loans, thereby expecting more credit risk. Additionally, results of revenue diversification provide evidence that banks are keen on non-traditional sources of income as one-third of their operating income comes from non-interest sources. This is because the survival of the banking industry is possible if they do not primarily depend on interest sources of income. Low variations in the values of bank size verify the stability of investment in assets by banks. Further, around 76% of the banks provide deposit insurance to protect deposits. Therefore, banks have also large deposits to assets ratio. The average outcome of asset growth specifies that banks are at a growing stage in this region. Although the inflation rate is not high, this region is affected by a large inflation rate as captured by maximum value and variation. Banks pay low average interest on their deposits. Furthermore, South Asian countries face variations in GDP growth due to unstable economies and political systems.

In addition, Appendix 1 to Appendix 8 are presented in the appendix section. However, Appendix 1 outlines tests for multicollinearity and correlation matrix. Results of the variance inflation factor (VIF) propose that the issue of multicollinearity does not prevail in the model of our study as the maximum value is within the prescribed range. Moreover, a correlation matrix is employed in Table 3 indicating the strength of relationships among explanatory variables. Outcomes of the correlation analysis show no high correlation among explanatory variables, suggesting that the multicollinearity problem does not prevail.

Appendix 2 provides the findings of panel regression of the present study while using a fixed effect model. Primary models of panel data regression contain random and fixed effects. The random effect shows a single common intercept, which varies randomly across firms. On the contrary, the fixed effect model comprises firm-specific intercepts remaining constant. While concentrating on variations within the bank over the study time period, the fixed effects estimate assists in mitigating potential biases as a result of these unobserved factors (Ahamed & Mallick, 2019), and offers a clear understanding of the analysis. This model is helpful in eradicating the influence of potential biases from omitted variables resulting in more accurate and precise estimates (Breuer & Dehaan, 2024). Further, fixed effect estimation is preferred mainly because it considers unobserved factors that differ across banks such as bank regulations and unique management within banks while remaining constant over time (Black et al., 2006). We use common, random, and fixed effect models to evaluate regression coefficients. However, after getting significant p-values from the Redundant and Hausman tests and following Arianpoor and Asali (2023), we select fixed effect estimation for analyzing data.

Findings of fixed effects reveal that both measures of capital adequacy ratio significantly and negatively affect bank credit risk behavior indicating that when banks fulfill capital adequacy requirements, credit risk is reduced. Banks aim to maintain an optimum level of capital adequacy for financial stability which in turn increases the trust of investors and depositors (Shim, 2013). In addition, capital adequacy requirements aim to ensure that banks possess sufficient capital to compensate for unanticipated losses caused by the risks they face in their routine operations, mainly credit risk. The negative effect of the capital adequacy ratio on credit risk follows the argument of Chiaramonte and Casu (2017). When banks increase their revenue sources beyond traditional sources, they face less credit risk because banks do not rely on a single source of income. Revenue diversification can help banks enhance financial stability, reduce distress, and make them more responsive to regulatory changes, thereby decreasing credit risk. Further, diversifying into more sources of income provides banks the opportunity to absorb losses resulting from lending activities.

Moreover, interest revenue is directly linked with the ability of borrowers to repay loan amounts. However, during an economic crisis, they may not be able to fulfill their liabilities which leads to increased bank credit risk. Therefore, non-interest income makes banks less dependent on the repayment of borrowers, decreasing the default risk of banks. The negative effects of bank revenue diversification on credit risk are related to the study of Abedifar et al. (2018). Further, by engaging more in non-traditional sources of income, banks in the South Asian region faceless credit risk, and financial distress is reduced (Chiorazzo et al., 2008). We take deposit insurance as a control variable as the majority of the banks provide deposit insurance for protecting depositors. Findings reveal that deposit insurance significantly reduces bank credit risk which supports the findings of (Demirgüç-Kunt & Huizinga, 2004) as moral hazard is minimized with deposit insurance. Bank size and credit risk have an inverse relationship signifying that large banks have more capability to mitigate risk due to more expertise, and greater capability to diversify their assets risk. Large banks have diversified portfolios allowing them to spread their risk among various sectors which reduces the effect of default in any of the areas. Cheng (2008) and Hunjra et al. (2021) also conclude that large banks have engaged in low levels of credit risk.

We find that liquidity significantly decreases bank risk as maintaining a strong liquidity position signals creditors, investors, and depositors that the bank is operating in good financial health, thereby decreasing the chances of credit risk. Further, maintaining more liquid assets enables banks to meet the withdrawals of depositors. The results of the study are interestingly similar to the findings of Ashraf et al. (2016). Assets growth shows that more investment in assets significantly increases bank credit risk because high asset growth needs extra financing which may lead to increased risk as found by Hunjra et al. (2021). We include macroeconomic variables to ensure that our outcomes are not biased. We find that an increase in both interest rate and inflation rate significantly enhances the chances of default on the part of borrowers as they find it difficult to repay loan amounts during tough economic conditions. We find that GDP growth significantly and adversely influences bank credit risk. This indicates that during a growing period of an economy, businesses perform better and financial institutions face less chances of credit risk as borrowers have more financial power to repay the loan amount. The results of macroeconomic factors are consistent with the studies of Hunjra et al. (2024) and Ghosh (2015).

5. Robustness tests

The study employed a generalized method of moments (GMM) for the robustness of the main findings in Appendix 3. We use GMM estimation along with the fixed effect model in our study as both approaches have their strengths such as fixed effect controls for unobserved heterogeneity, while the GMM approach addresses endogeneity concerns. Consequently, combining these techniques in our study provides more robust and reliable estimates. We employ GMM as this technique is used to handle the endogeneity issue which may occur due to a lagged dependent variable in the data which the fixed effect technique alone can not fairly address. This signifies that although the fixed effect model is helpful for controlling specific biases, however, it does not overcome the potential endogeneity problems relating to lagged dependent variables (Li et al., 2021). Therefore, it is pertinent to apply other techniques like system GMM to overcome such issues. For analyses, the study applied a two-step system dynamic panel estimation which is appropriate for the data with short time and long cross sections. Using the GMM technique is essential to provide robust checks. Further, this model is helpful in mitigating biases from unobserved heterogeneity which are considerable issues in our analysis (Kijkasiwat et al., 2022).

The method provides more consistent and robust outcomes by eliminating the endogeneity issues in our variables of concern (Haris et al., 2019), by using internal instruments to adjust for biases that appear due to endogeneity. The GMM technique is developed by Arellano and Bond (1991) and Arellano and Bover (1995). In addition, to ensure that the instruments are valid, we run the Sargan test. With insignificant p-values of this test, we confirm that the instruments of the study are valid. To check if there is autocorrelation in the data, we applied the Arellano-Bond test. Results demonstrate that AR1 has significant p-values, whereas AR2 has insignificant p-values which prove that no sign of autocorrelation exists in the second lag. However, the findings of the GMM technique are fairly similar to the primary model of the study.

Appendix 4 represents the regression findings regarding the interaction terms while analyzing the moderating influence of non-interest income on the association between capital regulation and bank credit risk. We find that the interaction of revenue diversification and capital regulation shows a detrimental effect on bank credit risk. The results imply that non-traditional sources of income and capital regulation lead to a more resilient banking system, which helps to minimize credit risk. Furthermore, non-traditional income increases the overall revenue of a bank, thereby supporting to keep regulatory capital as required. The negative impact indicates that fulfilling capital regulatory requirements and non-interest revenue sources reduces the chances of default risk which is consistent with the study of Shim (2013).

In addition, to further validate the findings of our study, we expand our analysis while presenting country-wise results in Appendix 5 to Appendix 8 while using a fixed effect model. We find that although there are small variations in the outcomes due to different economic conditions and banking systems of each country, however, overall findings are closely aligned with the main analysis which confirms that individual analysis of each country does not affect our main results. These small variations in the results are expected because of varying regulatory environments, banking systems, and economic conditions across countries. Further, the outcomes do not weaken the overall reliability and consistency of our findings.

6. Conclusions

Capital regulation plays a significant role in mitigating bank credit risk. Further, keeping an adequate level of capital while engaging in non-traditional-based earnings may lead to reduced credit risk. Our study aims to address a knowledge gap by analyzing the moderating influence of revenue diversification on the relationship between capital regulation and bank credit risk. While taking a sample of 102 banks from South Asia covering the period of 2011 to 2022, we apply static and dynamic panel regression models for analyzing the data. We find that capital regulation significantly reduces bank credit risk maintaining that while keeping an adequate level of capital, banks are expected to overcome unexpected losses including those linked with borrowers. Furthermore, by keeping adequate capital levels, banks are in a position to survive any adverse event that leads to credit risk. Considering the importance of regulatory capital, banks in South Asian countries follow to maintain the required level of capital to avoid any potential financial distress. We further conclude that by engaging in non-traditional-based earnings, banks are well-positioned to reduce credit risk. Additionally, relating to the interactive effect of non-interest income, we find that the interaction of revenue diversification has a significant and adverse relationship with the credit risk of banks. Therefore, various sources of income can benefit from strengthening the levels of capital, reducing the sole dependency on interest sources and bank lending.

The results drawn from the present study offer important policy implications for policymakers, management, investors, and regulators. As keeping a high level of regulatory capital minimizes the likelihood of credit risk, therefore, policymakers should focus on maintaining the required level of capital for financial stability. An adequate level of capital serves as a buffer contrary to unexpected losses, thereby decreasing the chances of bank failures. Moreover, our study may be helpful for regulatory authorities to strictly look after the banks so that they maintain adequate capital levels in order to maintain the confidence level of borrowers, and investors. Further, regulators should make sure that banks maintain minimum capital adequacy which is an important factor in mitigating credit risk. Considering the different operational contexts and risk profiles in different banks, regulators should develop a flexible regulatory rule that may be employed depending on the operational procedures of the banks. The findings of our study provide policy implications that when banks engage in non-traditional-based incomes along with interest income, the risk level is reduced. This negative impact implies that management should focus on diversifying bank sources of income to compete in a challenging banking environment. In line with this, policymakers and regulators should issue guidelines for banks to implement and explore strategies for revenue diversification. These guidelines may include providing frameworks for formulating and managing revenue streams other than interest sources. Furthermore, top management and policymakers should encourage training programs and the benefits of effective utilization of resources for bank management to improve their understanding of risk management policies and revenue diversification.

In addition, the results from country-wise analysis develop the practical relevance for bank management of each country in our sample by addressing these relationships in different economic and regulatory settings in these countries. This specifies that the findings are pertinent not only to one country but across the South Asian region. Banks should increase capital reserves, and develop financial products to meet economic challenges at regional levels while imposing regulatory capital needs and benefitting from diverse revenue sources. Therefore, our results highlight that improving adequacy requirements along with enhancing revenue diversification are important for stable banking operations across South Asian countries.

Although our study thoroughly investigates the impact of capital adequacy requirements on the bank credit risk by incorporating interactive effects of revenue diversification, still some limitations can be addressed in future studies. First, the study can be extended by taking the corporate governance variables with their potential impacts on the relationship between capital regulation and credit risk of banks. Second, comparing the results of banks in developing countries with those in developed economies could offer interesting insights for future investigation. This may help to highlight the probable differences concerning the regulatory effects and managing risk. Third, the same study can be extended by incorporating non-financial firms which may provide a deep understanding of how regulatory requirements are associated with credit risk in different sectors. Finally, future research might explore the current topic while considering macroeconomic conditions recognizing how external market dynamics influence the association between capital adequacy requirements and credit risk.

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Author Contributions
RM conceived, conducted a systematic literature review, and wrote the analysis. RYH performed data analysis, positioned the paper, and wrote the paper. YTB Collected the data, wrote the literature review section, contributed data or analysis tools. SR and TA wrote the literature, and were responsible for interpretation.

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There is no conflict of interest to be declared.

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Appendix

Appendix 1. Multicollinearity test and correlation matrix

	VIF	1/VIF	ZSC	NPL	LLP	CAR	CAP	RDV	DINS	BSZ	AGR	LIQ	INT	INF	GDP
ZSC			1												
NPL			0.057	1											
LLP			0.106	-0.267	1										
CAR	1.595	0.627	-0.138	0.093	-0.172	1									
CAP	1.635	0.611	-0.193	0.274	-0.206	0.075	1								
RDV	2.491	0.401	0.089	-0.425	0.358	-0.267	0.213	1							
DINS	1.938	0.516	0.127	-0.097	0.058	0.095	0.173	0.151	1						
BSZ	1.195	0.837	0.295	-0.301	0.194	0.114	0.106	0.211	-0.058	1					
AGR	1.379	0.725	0.327	-0.251	0.138	-0.341	-0.069	-0.516	0.223	0.179	1				
LIQ	1.978	0.506	-0.091	0.151	-0.278	0.278	0.213	0.341	0.161	0.167	0.107	1			
INT	1.798	0.556	-0.141	0.115	-0.067	0.071	-0.319	0.086	0.115	0.219	0.184	0.523	1		
INF	1.202	0.832	-0.106	0.245	-0.161	0.134	0.124	-0.124	0.102	-0.194	-0.143	-0.146	0.106	1	
GDP	1.833	0.546	0.342	-0.261	0.188	0.125	0.116	0.142	0.094	0.117	0.241	0.249	0.178	0.117	1

Source: Own processing.

Appendix 2. Fixed effect model

	Z-Score			NPL			LLP		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
CAR	0.852** (2.135)	______	0.037*** (6.316)	-0.534* (-1.825)	______	-1.041* (-1.792)	-0.372** (-2.419)	______	-0.112*** (-8.623)
CAP	______	0.134 (0.938)	0.552* (1.912)	______	-0.579* (-1.825)	-0.621* (-1.724)	______	-0.724*** (-5.632)	-0.082* (-1.735)
RDV	0.293*** (8.361)	1.216*** (5.392)	0.937** (2.115)	-0.345* (-1.734)	-0.935* (-1.768)	-0.275 (-1.104)	-0.663** (-2.418)	-0.578** (-2.345)	-0.417* (-1.847)
DINS	0.715* (1.823)	0.659 (1.212)	0.537* (1.728)	-0.628** (-2.314)	-0.428** (-2.712)	-0.043** (-2.172)	-0.828* (-1.798)	-0.437** (-2.341)	-0.046*** (-7.638)
BSZ	0.315*** (7.625)	0.415** (2.362)	0.118*** (6.395)	-0.518** (-2.178)	-0.385** (-2.375)	-0.668** (-2.321)	-0.085*** (-10.638)	-0.173*** (-5.362)	-0.669*** (-4.392)
AGR	-0.272 (-0.715)	-0.392* (-1.824)	-0.439* (-1.728)	0.051* (1.792)	0.127** (2.284)	0.594 (0.938)	0.923* (1.815)	0.017** (2.295)	0.319* (1.816)
LIQ	0.061*** (7.935)	0.031** (2.276)	0.182** (2.392)	-0.494* (-1.818)	-0.396 (-0.834)	-0.228* (-1.727)	-0.545 (-0.782)	-0.391* (-1.815)	-0.649** (-2.417)
INT	-0.414*** (-8.625)	-0.374** (-2.392)	-0.228* (-1.718)	0.083** (2.252)	0.623* (1.814)	0.362 (0.923)	0.346** (2.374)	0.485** (2.196)	0.282* (1.834)
INF	-0.242* (-1.826)	-0.362 (-0.743)	-0.081*** (-4.692)	0.173* (1.815)	0.295* (1.827)	0.516 (1.072)	0.037** (2.251)	0.764** (2.351)	0.281* (1.728)

GDP	0.158* (1.759)	0.392 (0.716)	0.664** (2.247)	-0.092** (-2.152)	-0.143** (-2.261)	-0.551* (-1.824)	-0.424* (-1.835)	-0.623 (-1.017)	-0.812** (-2.239)
C	-0.535* (-1.884)	-0.862* (-1.735)	-1.053** (-2.237)	1.124*** (5.936)	0.839** (2.231)	0.944*** (6.362)	0.715* (1.813)	0.082** (2.292)	0.515* (1.842)
Country dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-square	0.384	0.412	0.305	0.511	0.433	0.374	0.491	0.414	0393
F-statistics	9.562***	10.825***	9.635***	11.052***	10.934***	12.628***	10.362***	9.725***	8.926***
P-values (Likelihood test)	0.000	0.002	0.001	0.000	0.001	0.000	0.002	0.000	0.000
P-values (Hausman test)	0.003	0.000	0.000	0.000	0.002	0.001	0.000	0.001	0.000

Note: Model 1 = CAR as the dependent variable, Model 2 = CAP as dependent variable, Model 3 = Combined effects of CAR and CAP, where all three models are run with separate dependent variables, CAR = Capital adequacy ratio, CAP = Capital to risk-weighted assets, RND = Revenue diversification, BSZ = Bank size, DINS = Deposit insurance, AGR = Assets growth, LIQ = Liquidity, INT = Deposit interest rate, INF = Rate of inflation, GDP = GDP growth, C is Constant, while ***, **, and * show significance levels of the study at 1%, 5%, and 10% respectively. Source: Own processing.

Appendix 3. Two-step system dynamic panel estimation

	Z-Score			NPL			LLP		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
L1.	-0.007*** (-9.532)	-0.014*** (-10.392)	-0.052*** (-7.638)	0.081*** (4.392)	0.192** (2.405)	0.151** (2.234)	0.337** (2.285)	0.427* (1.813)	0.156** (2.236)
L2.	-0.134** (-2.182)	-0.391** (-2.381)	-0.561* (-1.754)	0.271* (1.816)	0.992* (1.762)	0.821* (1.795)	0.449** (2.281)	0.395* (1.782)	0.119** (2.296)
CAR	0.462** (2.274)	_______	0.002*** (8.935)	-0.448** (-2.315)	_______	-0.141** (-2.292)	-0.275** (-2.154)	_______	-0.052*** (-7.635)
CAP	_______	0.171* (1.862)	0.481* (1.755)	_______	-0.866* (-1.794)	-0.748** (-2.133)	_______	-0.494** (-2.235)	-0.175** (-2.236)
RDV	0.195** (2.186)	1.085*** (7.462)	0.846** (2.289)	-0.266* (-1.861)	-0.595* (-1.844)	-0.282* (-1.746)	-0.595* (-1.891)	-0.495*** (-3.964)	-0.513* (-1.794)
DINS	0.275* (1.776)	0.157* (1.712)	0.352* (1.835)	-0.712* (-1.825)	-0.584*** (-4.635)	-0.039*** (-3.895)	-0.798* (-1.844)	-0.437* (-1.815)	-0.018*** (-8.935)
BSZ	0.285*** (5.635)	0.261*** (4.584)	0.057*** (7.621)	-0.447** (-2.186)	-0.414** (-2.286)	-0.746** (-2.362)	-0.004*** (-8.469)	-0.246** (-2.291)	-0.585** (-2.254)
AGR	-0.412 (-0.855)	-0.484** (-2.295)	-0.581** (-2.196)	0.125* (1.846)	0.242* (1.901)	0.498 (0.776)	0.785* (1.727)	0.196* (1.718)	0.576 (1.102)
LIQ	0.027*** (8.678)	0.185* (1.791)	0.274*** (4.392)	-0.542** (-2.296)	-0.396* (-1.705)	-0.358 (-0.931)	-0.428 (-0.834)	-0.245** (-2.239)	-0.434* (-1.782)

INT	-0.231*** (-6.295)	-0.420** (-2.273)	-0.584** (-2.189)	0.157*** (4.452)	0.592 (1.024)	0.243* (1.722)	0.359*** (4.306)	0.379** (2.323)	0.341** (2.251)
INF	-0.257* (-1.813)	-0.416* (-1.781)	-0.192** (-2.236)	0.224 (0.979)	0.288* (1.782)	0.578* (1.779)	0.061** (2.295)	0.764* (1.897)	0.342 (1.124)
GDP	0.551** (2.241)	0.431* (1.719)	0.881* (1.796)	-0.012* (-1.823)	-0.143* (-1.708)	-0.203 (-0.882)	-0.451** (-2.251)	-0.691* (-1.778)	-0.785* (-1.843)
C	-0.612** (-2.168)	-1.114** (-2.213)	-1.107*** (-4.265)	1.103*** (6.227)	0.0.582*** (4.442)	0.916** (2.253)	0.648** (2.263)	0.532* (1.782)	0.424* (1.902)
Country dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Sargan test (P-values)	0.181	0.218	0.207	0.236	0.229	0.318	0.297	0.274	0.310
AR1 (P-values)	0.085***	0.027***	0.127***	0.079***	0.004***	0.029***	0.115***	0.058***	0.019***
AR1 (P-values)	0.598	0.765	0.679	0.804	0.738	0.869	0.591	0.878	0.798

Note: Model 1 = CAR as dependent variable, Model 2 = CAP as dependent variable, Model 3 = Combined effects of CAR and CAP, where all three models are run with separate dependent variables, L1 = First lag of dependent variable, L2 = Second lag of dependent variable. Source: Own processing.

Appendix 4. Indirect effect

	Z-Score			NPL			LLR		
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
CAR	0.417* (1.849)	_______	0.312* (1.824)	-0.384** (-2.419)	_______	-0.421* (-1.816)	-1.152** (-2.182)	_______	-1.062** (-2.279)
CAP	_______	0.195** (2.424)	0.979* (1.825)	_______	-0.784* (-1.771)	-0.351** (-2.150)	_______	-0.597** (-2.284)	-0.396* (-1.815)
CAR*RDV	0.374** (2.175)	_______	0.316* (1.825)	-0.004*** (-5.286)	_______	-0.371** (-2.315)	-0.784* (-1.816)	_______	-0.412** (-2.391)
CAP*RDV	_______	0.085** (2.316)	0.031*** (5.291)	_______	-0.062** (-2.263)	-0.476** (-2.236)	_______	-0.361** (-2.381)	-0.439* (-1.837)
DINS	0.767* (1.834)	0.005** (2.391)	0.103** (2.212)	-0.635** (-2.142)	-0.117** (-2.285)	-0.316** (-2.278)	-0.173** (-2.279)	-0.418** (-2.384)	-0.229* (-1.798)
BSZ	0.443* (1.867)	0.362* (1.724)	0.575 (0.837)	-0.291* (-1.724)	-0.815* (-1.759)	-0.435 (-0.849)	-0.585*** (-4.935)	-0.275*** (-5.965)	-0.395** (-2.415)
AGR	-0.007** (-2.369)	-0.102* (-1.814)	-0.344** (-2.242)	0.142*** (5.821)	0.017** (2.189)	0.615* (1.857)	0.228* (1.727)	0.845 (0.921)	0.497* (1.835)
LIQ	0.769 (0.937)	0.338* (1.712)	0.275* (1.815)	-0.304* (-1.815)	-0.441** (-2.274)	-0.236* (-1.849)	-0.465 (-1.062)	-0.665* (-1.911)	-0.596* (-1.876)

INT	-0.061*** (-4.535)	-0.036*** (-5.345)	-0.057** (-2.278)	0.591** (2.162)	0.007*** (4.935)	0.315** (2.361)	0.823* (1.835)	0.274* (1.759)	0.735* (1.856)
INF	-0.244* (-1.895)	-0.143 (-0.795)	-0.889* (-1.901)	0.552* (1.758)	0.277* (1.891)	0.349** (2.272)	0.495* (1.735)	0.235 (0.985)	0.557* (1.898)
GDP	0.164* (1.773)	0.432** (2.392)	0.628** (2.323)	-0.052** (-2.315)	-0.219* (-1.857)	-0.615* (-1.911)	-0.485* (-1.795)	-0.395* (-1.819)	-0.498** (-2.278)
C	-1.021*** (-8.635)	-1.083*** (-7.692)	-0.979** (-2.401)	0.778** (2.346)	0.594* (1.849)	0.761* (1.859)	0.823** (2.395)	0.389** (2.359)	0.198** (1.756)
Year dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Country dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-square	0.432	0.356	0.375	0.458	0.492	0.424	0.427	0.381	0.543
F-statistics	10.536***	9.263***	11.362***	12.715***	10.639***	11.362***	9.137***	10.278***	8.395***
P-values (Likelihood test)	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.002
P-values (Hausman test)	0.001	0.003	0.000	0.000	0.002	0.001	0.000	0.000	0.001

Source: Own processing.

Appendix 5. Country-wise fixed effect analysis

	Pakistan								
	Z-Score			NPL			LLP		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CAR	0.759*** (3.935)	_______	0.058*** (4.675)	-0.498** (-2.395)	_______	-0.596** (-2.278)	-0.495* (-1.935)	_______	-0.295*** (-6.935)
CAP	_______	0.075* (1.845)	0.469* (1.898)	_______	-0.485 (-1.107)	-0.469** (-2.263)	_______	-0.484** (-2.415)	-0.106 (-0.937)
RDV	0.424*** (9.769)	0.979*** (4.628)	0.745*** (5.965)	-0.798 (-0.839)	-0.767** (-2.484)	-0.319* (-1.785)	-0.757* (-1.911)	-0.575 (-1.124)	-0.704** (-2.349)
CAR* RDV	0.053** (2.296)	_______	0.062** (2.237)	-0.535* (-1.852)	_______	-0.085** (-2.424)	-0.237 (-0.798)	_______	-0.424* (-1.855)
CAP*RDV	_______	0.134* (1.835)	0.425* (1.798)	_______	-0.434 (-0.935)	-0.137** (-2.494)	_______	-0.035** (-2.392)	-0.395* (-1.798)
DINS	0.485** (2.296)	0.223* (1.874)	0.499 (0.589)	-0.285* (-1.765)	-0.344* (-1.822)	-0.063** (-2.645)	-0.787** (-2.285)	-0.577* (-1.795)	-0.017** (-2.411)
BSZ	0.378** (2.454)	0.512** (2.395)	0.075*** (4.653)	-0.478*** (-3.989)	-0.488*** (-3.895)	-0.787*** (-4.088)	-0.007*** (-9.462)	-0.017*** (-4.855)	-0.775*** (-5.965)
AGR	-0.179 (-0.824)	-0.498 (-0.709)	-0.792* (-1.878)	0.198* (1.699)	0.239* (1.811)	0.594 (0.938)	0.338** (2.295)	0.469 (0.971)	0.432** (2.401)

LIQ	0.042*** (8.392)	0.008*** (4.638)	0.721** (2.638)	-0.144** (-2.285)	-0.421* (-1.833)	-0.394 (-1.086)	-0.499* (-1.874)	-0.498** (-2.385)	-0.566* (-1.725)
INT	-0.185*** (-10.395)	-0.498*** (-5.695)	-0.491** (-2.385)	0.162 (0.795)	0.471** (2.378)	0.424** (2.401)	0.546* (1.865)	0.395* (1.727)	0.134** (2.227)
INF	-0.051** (-2.396)	-0.195* (-1.842)	-0.078** (-2.267)	0.274 (0.935)	0.485** (2.341)	0.471* (1.711)	0.041* (1.854)	0.761** (2.402)	0.375** (2.434)
GDP	0.086 (1.124)	0.431* (1.826)	0.798** (2.357)	-0.128*** (-4.697)	-0.562*** (-3.678)	-0.025** (-2.451)	-0.465** (-2.237)	-0.524* (-1.773)	-0.569* (-1.825)
C	-0.495* (-1.910)	-0.796 (-0.938)	-1.262* (-1.867)	0.917** (2.338)	0.495** (2.193)	0.298 (0.412)	0.528** (2.237)	0.002*** (4.639)	0.515** (2.398)
Country dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-square	0.384	0.412	0.305	0.511	0.433	0.374	0.491	0.414	0393
F-statistics	10.938***	9.795***	11.506***	10.952***	13.496***	11.397***	8.936***	10.395***	9.366***
P-values (Likelihood test)	0.000	0.001	0.002	0.000	0.000	0.002	0.001	0.000	0.000
P-values (Hausman test)	0.002	0.000	0.003	0.000	0.001	0.000	0.002	0.000	0.001

Source: Own processing.

Appendix 6. Country-wise fixed effect analysis

	Pakistan								
	Z-Score			NPL			LLP		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CAR	0.759*** (3.935)	_______	0.058*** (4.675)	-0.498** (-2.395)	_______	-0.596** (-2.278)	-0.495* (-1.935)	_______	-0.295*** (-6.935)
CAP	_______	0.075* (1.845)	0.469* (1.898)	_______	-0.485 (-1.107)	-0.469** (-2.263)	_______	-0.484** (-2.415)	-0.106 (-0.937)
RDV	0.424*** (9.769)	0.979*** (4.628)	0.745*** (5.965)	-0.798 (-0.839)	-0.767** (-2.484)	-0.319* (-1.785)	-0.757* (-1.911)	-0.575 (-1.124)	-0.704** (-2.349)
CAR* RDV	0.053** (2.296)	_______	0.062** (2.237)	-0.535* (-1.852)	_______	-0.085** (-2.424)	-0.237 (-0.798)	_______	-0.424* (-1.855)
CAP*RDV	_______	0.134* (1.835)	0.425* (1.798)	_______	-0.434 (-0.935)	-0.137** (-2.494)	_______	-0.035** (-2.392)	-0.395* (-1.798)
DINS	0.485** (2.296)	0.223* (1.874)	0.499 (0.589)	-0.285* (-1.765)	-0.344* (-1.822)	-0.063** (-2.645)	-0.787** (-2.285)	-0.577* (-1.795)	-0.017** (-2.411)
BSZ	0.378** (2.454)	0.512** (2.395)	0.075*** (4.653)	-0.478*** (-3.989)	-0.488*** (-3.895)	-0.787*** (-4.088)	-0.007*** (-9.462)	-0.017*** (-4.855)	-0.775*** (-5.965)
AGR	-0.179 (-0.824)	-0.498 (-0.709)	-0.792* (-1.878)	0.198* (1.699)	0.239* (1.811)	0.594 (0.938)	0.338** (2.295)	0.469 (0.971)	0.432** (2.401)

LIQ	0.042*** (8.392)	0.008*** (4.638)	0.721** (2.638)	-0.144** (-2.285)	-0.421* (-1.833)	-0.394 (-1.086)	-0.499* (-1.874)	-0.498** (-2.385)	-0.566* (-1.725)
INT	-0.185*** (-10.395)	-0.498*** (-5.695)	-0.491** (-2.385)	0.162 (0.795)	0.471** (2.378)	0.424** (2.401)	0.546* (1.865)	0.395* (1.727)	0.134** (2.227)
INF	-0.051** (-2.396)	-0.195* (-1.842)	-0.078** (-2.267)	0.274 (0.935)	0.485** (2.341)	0.471* (1.711)	0.041* (1.854)	0.761** (2.402)	0.375** (2.434)
GDP	0.086 (1.124)	0.431* (1.826)	0.798** (2.357)	-0.128*** (-4.697)	-0.562*** (-3.678)	-0.025** (-2.451)	-0.465** (-2.237)	-0.524* (-1.773)	-0.569* (-1.825)
C	-0.495* (-1.910)	-0.796 (-0.938)	-1.262* (-1.867)	0.917** (2.338)	0.495** (2.193)	0.298 (0.412)	0.528** (2.237)	0.002*** (4.639)	0.515** (2.398)
Country dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-square	0.384	0.412	0.305	0.511	0.433	0.374	0.491	0.414	0393
F-statistics	10.938***	9.795***	11.506***	10.952***	13.496***	11.397***	8.936***	10.395***	9.366***
P-values (Likelihood test)	0.000	0.001	0.002	0.000	0.000	0.002	0.001	0.000	0.000
P-values (Hausman test)	0.002	0.000	0.003	0.000	0.001	0.000	0.002	0.000	0.001

Source: Own processing.

Appendix 7. Country-wise fixed effect analysis

	Sri Lanka								
	Z-Score			NPL			LLP		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
CAR	0.496* (1.834)	_______	0.692** (2.367)	-0.634 (-0.792)	_______	-0.162* (-1.825)	-0.741** (-2.294)	_______	-0.645** (-2.278)
CAP	_______	0.515 (1.034)	0.845** (2.414)	_______	-0.364* (-1.704)	-0.812* (-1.792)	_______	-0.595* (-1.755)	-0.231* (-1.814)
IDV	0.724*** (5.345)	0.594** (2.574)	0.294** (2.364)	-0.822* (-1.761)	-0.649* (-1.876)	-0.518 (-0.675)	-0.694** (-2.294)	-0.915* (-1.844)	-0.578*** (-3.792)
CAR*RDV	0.002*** (5.635)	_______	0.152** (2.378)	-0.785 (-0.811)	_______	-0.072** (-2.217)	-0.595 (-0.782)	_______	-0.432** (-2.183)
CAP*RDV	_______	0.241*** (4.631)	0.543** (2.269)	_______	-0.787* (-1.802)	-0.053* (-1.771)	_______	-0.122* (-1.843)	-0.031*** (-3.629)
DINS	0.575* (1.834)	0.664 (0.539)	0.591* (1.746)	-0.413** (-2.284)	-0.541** (-2.419)	-0.005*** (-4.637)	-0.597* (-1.749)	-0.394 (-0.743)	-0.115* (-1.721)
BSZ	0.187 (0.694)	0.434* (1.781)	0.271* (1.876)	-0.267** (-2.175)	-0.615*** (-4.551)	-0.841** (-2.062)	-0.014*** (-5.395)	-0.177** (-2.274)	-0.613** (-2.167)
AGR	-0.151* (-1.773)	-0.694* (-1.725)	-0.495* (-1.815)	0.346** (2.217)	0.194 (0.732)	0.612* (1.797)	0.554* (1.801)	0.254* (1.841)	0.842* (1.730)

LIQ	0.014*** (5.634)	0.014*** (6.725)	0.875** (2.427)	-0.124* (-1.725)	-0.513** (-2.298)	-0.422* (-1.851)	-0.615 (-0.716)	-0.826* (-1.733)	-0.944** (-2.431)
INT	-0.007*** (-8.765)	-0.922*** (-3.468)	-0.534** (-2.416)	0.832 (0.943)	0.342* (1.794)	0.274* (1.914)	0.693** (2.275)	0.559 (0.873)	0.218* (1.729)
INF	-0.107** (-2.410)	-0.431** (-2.158)	-0.121* (-1.882)	0.531 (0.764)	0.610* (1.743)	0.349 (0.594)	0.106** (2.344)	0.596* (1.815)	0.764* (1.834)
GDP	0.105* (1.761)	0.274 (0.893)	0.591* (1.834)	-0.172** (-2.421)	-0.695** (-2.278)	-0.018*** (-4.678)	-0.795* (-1.832)	-0.834* (-1.709)	-0.449 (-0.795)
C	-0.486* (-1.757)	-0.595* (-1.914)	-0.846** (-2.263)	0.637* (1.795)	1.095*** (3.795)	0.483* (1.792)	0.394 (0.820)	0.015** (2.298)	0.691*** (4.291)
Country dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-square	0.427	0.507	0.394	0.445	0.527	0.316	0.472	0.451	0376
F-statistics	13.492***	10.135***	12.495***	9.934***	8.554***	10.196***	12.964***	10.965***	11.693***
P-values (Likelihood test)	0.001	0.000	0.003	0.002	0.000	0.001	0.000	0.000	0.001
P-values (Hausman test)	0.001	0.000	0.001	0.000	0.000	0.000	0.003	0.001	0.000

Source: Own processing.

Appendix 8. Country-wise fixed effect analysis

	Bangladesh								
	Z-Score			NPL			LLP		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CAR	0.532** (2.287)	_______	0.945 (0.734)	-0.354** (-2.263)	_______	-0.512** (-2.422)	-0.632 (-0.594)	_______	-0.845* (-1.714)
CAP	_______	0.821* (1.791)	0.495* (1.832)	_______	-0.561 (-0.831)	-0.064** (-2.416)	_______	-0.915** (-2.252)	-0.337* (-1.791)
IDV	0.566* (1.809)	0.131* (1.724)	0.064* (1.799)	-0.595** (-2.263)	-0.422 (-1.048)	-0.192** (-2.419)	-0.551** (-2.349)	-0.054** (-2.283)	-0.816** (-2.179)
CAR*RDV	0.018** (2.415)	_______	0.274* (1.816)	-0.115** (-2.379)	_______	-0.105 (-0.558)	-0.185** (-2.279)	_______	-0.558*** (-4.639)
CAP*RDV	_______	0.516** (2.358)	0.601* (1.791)	_______	-0.137** (-2.296)	-0.007** (-2.298)	_______	-0.167** (-2.410)	-0.161** (-2.164)
DINS	0.167** (2.384)	0.485* (1.899)	0.794** (2.427)	-0.634** (-2.322)	-0.989*** (-4.065)	-0.027** (-2.431)	-0.721** (-2.297)	-0.655* (-1.835)	-0.054** (-2.183)
BSZ	0.251** (2.417)	0.357** (2.361)	0.661* (1.714)	-0.591*** (-3.967)	-0.051** (-2.391)	-0.558** (-2.427)	-0.514 (-0.876)	-0.135 (-1.062)	-0.594* (-1.821)
AGR	-0.794** (-2.182)	-0.392** (-2.204)	-0.442 (-0.864)	0.561* (1.727)	0.496** (2.263)	0.279 (0.462)	0.314** (2.405)	0.132* (1.721)	0.924 (1.061)

LIQ	0.181** (2.197)	0.117*** (4.637)	0.338** (2.264)	-0.042** (-2.379)	-0.772* (-1.851)	-0.691 (-0.732)	-0.446** (-2.431)	-0.553 (-0.812)	-0.106* (-1.754)
INT	-0.105** (-2.424)	-0.484 (-0.767)	-0.133* (-1.857)	0.108 (0.596)	0.553** (2.378)	0.318** (2.388)	0.597* (1.899)	0.377** (2.256)	0.356 (0.694)
INF	-0.052** (-2.335)	-0.392** (-2.441)	-0.021*** (-5.395)	0.391* (1.814)	0.559 (1.031)	0.053** (2.285)	0.245* (1.892)	0.447** (2.263)	0.387** (2.298)
GDP	0.204** (2.387)	0.115* (1.794)	0.677** (2.284)	-0.054*** (-3.967)	-0.117** (-2.294)	-0.036** (-2.597)	-0.264* (-1.914)	-0.696** (-2.388)	-0.366* (-1.759)
C	-0.235* (-1.849)	-0.769 (-0.578)	-0.577** (-2.404)	0.937** (2.276)	0.977*** (4.638)	0.057*** (6.395)	0.371* (1.766)	0.622 (0.719)	0.596** (2.381)
Country dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-square	0.372	0.412	0.471	0.513	0.493	0.384	0.524	0.394	0405
F-statistics	10.966***	9.795***	10.227***	8.937***	10.224***	9.067***	11.492***	9.695***	10.696***
P-values (Likelihood test)	0.002	0.000	0.000	0.001	0.001	0.000	0.000	0.002	0.000
P-values (Hausman test)	0.000	0.000	0.003	0.001	0.000	0.002	0.002	0.000	0.000

Source: Own processing.