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Impact of COVID-19 on the Performance of Commercial Banks of Bangladesh: A Comparative Analysis of Pre-COVID, COVID Period and the Determinants for Post-COVID Performance

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Abstract

This study, comprising two studies, investigates the performance of commercial banks in the pre-COVID and COVID periods and the determinants of post-COVID performance. The empirical investigation of system GMM of study one from 2014 to 2021 points to a few significant insights. Commercial banks' risk increased substantially in the COVID period compared to the pre-COVID period, whereas stability addressed through the Z-score depicts the reverse results of risk. That means that the stability of the pre-COVID period was superior to that of commercial banks during the COVID period. It refers to the performance of banks from a risk-stability perspective becoming worse in the COVID period than in the pre-COVID period. Banks' profitability also reduced in the COVID period compared to the pre-COVID period of commercial banks. Return on assets (ROA) and Pre-tax profit significantly reduced in the COVID period compared to pre-COVID counterparts. However, we did not find any significant impact of the COVID period on banks' return on equity (ROE). Surprisingly, the efficiency of commercial banks was enhanced in the COVID period compared to pre-COVID periods in the Bangladeshi banking industry. Both revenue and human capital efficiency increased in the COVID period rather than in the immediate pre-COVID period in Bangladesh. Therefore, it is apparent that in the COVID period, banks' risk and profitability deteriorated, whereas the efficiency of banks was enhanced. Study two delves into the determinants that significantly impact the post-COVID performance of commercial banks. The study pinpoints liquidity, bank size, operating efficiency, assets quality, and corporate governance as bank-specific factors, as well as inflation and exchange rate as macroeconomic factors that significantly impact the post-COVID performance of commercial banks in Bangladesh. However, we found no significant impact of industry-specific variables in post-COVID performance.

Keywords: *COVID, System GMM, Risk, Stability, Efficiency*

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1. Introduction

COVID-19, the most recent pandemic, caused trouble around the globe in the early of 2020. From the first trace of coronavirus in Wuhan city, China, this deadly virus embraces its black paw to human lives and continues. Till July 8, 2020, the death case was 539906, and the number of confirmed cases was 11669259 [1]. COVID-19 became an unprecedented and devastating disease that hit the health administration and jeopardized the economy all over the world. As a primary channel of economic flow, the banking industry is not excluded from the bad effects of the COVID-19 breakout.

There are rising research works on COVID-19 and its effect on financial markets. For example, Ashraf [2], Al-Awadhi, et al. [3], Zhang, et al. [4], and Wagner [5] explore the impact of the COVID-19 daily cases on the financial market index. Onali [6] also examines the implications of COVID-19 in the US and Chinese stocks. However, the impact of COVID-19 on the banking industry has yet to be reviewed. The banking industry has always debated risk, profitability, and efficiency. Commercial banks always tradeoff between risk and profitability as these two are interrelated [7][8]. However, in the risk-taking trend, efficiency also becomes a worth considering factor. Thus, the concurrent relationship between risk, profitability, and efficiency draws the attention of researchers due to the bidirectional relationship with each other [9][10]. The impact of COVID-19 across the world is not the same. The confirmed cases death cases in the USA and Italy are more severe than in the Asian region. Surprisingly, death cases in Asian countries are not as acute as in most developed countries like the USA, Italy, etc.

Like all other countries, Bangladesh is also fighting against COVID-19. However, critics appraise the Bangladeshi economy as resilient compared to other Asian countries like Pakistan, India, etc. Research questions arise on how Bangladesh's economic channel is performing in this COVID situation. Compared to previous accounting periods, are the risk-taking and profitability adversely affected in the COVID period? Will the efficiency of banks be compromised due to the crisis period? Do banks' deposits and assets growth continue to the previous trend or drop in this period? What are market practitioners' plans and strategies to combat the post-COVID crisis and revive the market?

This study opts for an in-depth analysis to address the above research questions. The study also addresses the COVID effect on risk, profitability, and efficiency of commercial banks in Bangladesh and the determinants of post-COVID variables to enhance commercial banks' performance.

2. Literature review

2.1. Literature addressing the impact of COVID-19 on the performance of commercial banks in Bangladesh:

Any economic crisis also becomes a crisis for banks, and the banking failure of an economy hits the global banking system. The world never observes such death casualties from disease. Following the severity of the disease, the World Health Organization (WHO) declared the condition a pandemic in March 2020. Countries like China, Russia, Italy, France, Spain, Germany, Brazil, the UK, and the US have suffered severe COVID-19 outbreaks. The deadly virus is breaking almost all countries' health administrations and destroying the economic base for many countries' sustainability.

There are limited yet increasingly rising works about COVID-19 and its effect on the financial system. For example, Ashraf [2], Al-Awadhi, et al. [3], Zhang, et al. [4], and Wagner

[5] explore the impact of the COVID-19 daily cases on the financial market indices. A Survey by Onali [6] depicts the insignificant effect of COVID-19 on the US financial market. Park and Shin [11] also opine that the COVID pandemic increases nonperforming loans in the banking system globally. The authors also pointed out that the effect is severe in emerging markets. Similarly, Beck and Keil [12] also provide evidence of the impact of COVID on loan provisioning and nonperforming loans. Loan loss provisioning and nonperforming loans have increased significantly; syndicated loans have reduced substantially, and the intermediation benefit of banks has also decreased in the COVID situation.

Another study by Katusiime [13] examines the impact of COVID on banks' profitability. The author addresses profitability through net interest margin, return on assets, and return on equity. All profitability measures observe an inverse impact on profitability in the COVID outbreak. Financial performance in the form of liquidity risk, asset risk, default risk, and stability also deteriorates due to the detrimental outbreak of the COVID pandemic. This result is almost similar in the US, China, and other countries. However, results are diversified in Islamic and conventional banks [14].

Surprisingly, the impact of COVID-19 is not equal for all countries. In a few countries, the financial performance of specific sectors improves, whereas most countries of the same industry deteriorate. Atayah, et al. [15] examined the impact of COVID-19 on G-20 countries and observed the financial performance of 14 logistic firms out of 20 during the COVID period enhanced, and the remaining six deteriorated. Again, Garib and Kumar [16] opine that the impact of COVID will not be equal for all sectors of the economy. Few sectors will return faster to the normal phase than most economic sectors. The survey of India depicts that industries like tourism, travel, and banking are affected mainly by COVID and will take a long time to revive their previous position. Pharmaceuticals, e-commerce, FMCG, etc., are the least affected and will rebound soon. In most countries, the pandemic situation adversely affects the banking sector. Adverse economic conditions increase operating costs and operational risks, affecting banks' income and risk [17].

However, a study specifically examining the impact of COVID-19 on commercial banks is scared in the available literature. In the study of Polish Banks, Kulińska-Sadłocha, et al. [18] opine that banks are facing a liquidity crisis preceding the COVID-19 crisis. The authors point out some anti-crisis measures of Polish banks, like changes in receivables and their provisioning, liquidity support from the central bank, etc. Demirguc-Kunt, et al. [19] also support the initiative of borrower assistance, liquidity, ease of loan formalities, etc. The authors also argue that although these initiatives moderate the adverse pandemic effect, the impact varies across countries and banks.

However, the risk-taking tendency of commercial banks decreases despite liquidity support from the central bank. Barua and Barua [20] evidence the impact of COVID on bank risk, regulatory capital, firm value, and profitability of banks. The authors argue that large-sized banks are more vulnerable than their counterparts, and the COVID situation decreases banks' interest income. The declining interest, firm value, and regulatory capital compliance trend may create an enormous shock of nonperforming loans for banks.

Rizwan, et al. [21] argue that the economic shock of COVID has similar vulnerabilities on both Islamic and conventional banks to idiosyncratic risk. However, Islamic banks have less spillover effect in earning abnormal returns than conventional banks. The authors also opine that Islamic banks have more resilience than others in financial crises due to their risk-sharing nature, giving them a unique risk absorption advantage. Again, Hassan, et al. [22] preach that the impact of COVID differs from banks' ownership. Islamic banks face more challenges in alternative sustainable finance to face COVID. They also opine that Islamic banks are badly

affected during the COVID pandemic. The authors advocate the adaptation of fintech to address the pandemic challenges. However, the literature does not uniformly suggest remedial steps to face pandemic challenges. Li, et al. [23] found that tightening credit regulation squeezed banks' traditional investment and inversely affected banks' performance. The author opines that income diversification has a positive effect in enhancing banks' performance and managing risk. Marcu [24] preaches that fintech and technological adaptation is time demanded to adjust to the new normal COVID situation. The author documented that to meet customer expectations of cost reduction, and banks accelerated digitalization in banking. However, Demir and Danisman [25] point out that capitalized banks with good deposits base, larger asset sizes, and lower nonperforming loans show more resilience in their earnings than other counterparts in the pandemic.

In contrast, high CSR activities show a negative impact on the earnings of the banks. Duan, et al. [26] opine that the performance of banks during the pandemic deviates from banks' assets-liabilities exposure, bank regulations like deposit insurance, and ownership structure. Thus, the performance of banks during the pandemic is not uniform over banks' size and ownership structure.

Banks dealing with pandemic situations like Ebola and Sars virus are well prepared to deal with COVID-19 due to their previous experience and quick response through prudential regulatory changes and infrastructure [18]. However, countries like Bangladesh are experiencing such a crisis for the first time and have yet to pinpoint the remedy for such a crisis efficiently. As a third-world country, customers' economic situation significantly impacts banks' deposits and loans. The health crisis significantly affects customers' deposits in banks. Therefore, customers' deposit withdrawal due to health hazards and the economic crisis has significant over the lending capacity of banks. Deposit withdrawals of customers create a liquidity crisis for commercial banks. Moreover, the liquidity crisis of business organizations is also acute by the lockdown decision of the Government and the economic situation in the form of reduced sales and reduction of exports. Flögel and Gärtner [27] suggest liquidity support to business clients as a cushion for the social shutdown during the COVID-19 pandemic.

The available literature shows that the impact of the recent pandemic is not equal for all sectors of the economy. Again, the effect also differs concerning ownership, size, etc. [22]. Moreover, other literature has different suggestions for facing the challenges of the COVID pandemic and enhancing performance. Thus, there is a specific demand for examining the comparative impact of COVID-19 on the banking industry of Bangladesh and pointing out the determinants of commercial banks' performance in a post-COVID situation.

Thus, there is a specific research question that the study intends to address. Do banks' COVID period performance significantly differ from the pre-COVID situations? How were banks' risk and other performance indicators affected during COVID? Is the effect of COVID homogeneous or heterogeneous across ownership and size of banks? What are the determinants that will enhance the performance of the post-COVID situation?

This study empirically investigates and reveals significant insights into the impact of the COVID crisis, using Bangladesh as a sample study in Asia. It also suggests probable remedies to face the post-COVID situation.

To survey the effect of COVID-19 on the risk, profitability, and efficiency of banks, the relevant hypotheses of the study are (For study one):

H_{11}: There is a significant impact COVID period on the risk-taking of banks.

H_{12}: There is a significant impact of COVID period on bank efficiency.

H_{13}: There is a significant impact COVID period on the profitability of banks.

3. Methodology of the study

This study conducted two studies to complete the project. The study opted for a hybrid approach (Secondary data-based and field studies) to delve into the investigation.

Study one covers the empirical investigation using secondary data, while study two is on a primary data survey to pinpoint the determinants of future post-COVID performance.

In this section, we cover the methodology of Study one to delve into the impact of COVID-19 on the performance of commercial banks in Bangladesh.

3.1. Description of data and scope of the study

This study collects all bank-level information from the audited annual reports of respective banks for the period of 2014-2021. Macroeconomic and industry-specific data are sourced from the World Bank dataset. Information relating to the banking industry of Bangladesh is also collected from Bangladesh Bank websites (Annual report 2020-2021, Bangladesh Bank).

At present, 61 commercial banks are operating in the industry. Foreign banks are excluded from the observation because the information on foreign banks is not readily available and reported from a country-specific perspective. Besides this, necessary adjustments were taken to address the outlier effect. Finally, we have 44 banks for empirical investigation after the projected exclusion.

3.2. Definition of variables

3.2.1. Risk measures

To address risk, we opt for NPLTL to address credit risk and Z-score to stability.

Credit risk (NPLTL):

Following the literature of Chaibi and Ftiti [28], Gupta and Yesmin [29], , among others, credit risk is also examined using the ratio of Non-Performing Loans to Total Loans and Advances (NPLTL) for the sample banks throughout the period.

A higher ratio NPLTL indicated more credit risk exposure.

$$\boldsymbol{NPTL} = \frac{\boldsymbol{Non-performing\ Loan}}{\boldsymbol{Total\ Loan\ and\ Advances}} \tag{1}$$

Stability Risk (Z-score): The Z-score denoted the direct measure of stability, the reverse measure of credit risk. Using the following formula, we measure the Z-score.

$$\textbf{Z-score} = \frac{(\boldsymbol{CAR+ROA})}{\boldsymbol{\delta(ROA)}} \tag{2}$$

A higher Z-score ratio signifies greater stability and reduced risk of insolvency for banks [30].

3.2.2. Profitability:

To measure profitability, this study opts for three measures. These are:

Return on Assets (ROA): Return on assets refers to the net outcomes against the banks' assets. This study used information on ROA from the reported information of respective banks' annual reports.

Return on Equity (ROE): Return on equity denotes the bank's return against the share outstanding. ROE, like information on return on assets, is also collected from banks' annual reports.

Pre-tax Profit (PBT): Information on pre-tax profit collected from the annual reports of respective banks for the corresponding years.

3.2.3. Efficiency measure

Inspired by the study of Gupta and Yesmin [29], Kasman and Carvallo [31], Zheng, et al. [7], and Gupta, et al. [32], Cost efficiency, Revenue efficiency, and Human Capital efficiency measured using SFA.

The translog cost function of measuring efficiency with two outputs and three inputs against the dependent variable is below [33].

$$\text{Ln TC} = \alpha + \sum_i \alpha_i \, lnQ_i + \sum_j \beta_j \, lnP_j + \tfrac{1}{2} \sum_i \sum_k \gamma_{ik} \, lnQ_i lnQ_k + \tfrac{1}{2}$$

$$\sum_j \sum_h \delta_{jh} \, lnP_j lnP_h + \sum_i \sum_j \lambda_{ij} \, lnQ_i lnP_j + \varepsilon \quad (3)$$

Here, TC refers to the total cost. Transforming the error term subtraction to addition also measures revenue and human capital efficiency following the production function of Coelli[34].

The description of the dependent and other variables is illustrated in Table 1.

Table 1. Description of variables in empirical investigations

Variables	Acronym	Definition	Sources / References)
Dependent Variables			
Risk – Credit risk	NPLTL	Non-performing loans to total loans	Chaibi and Ftiti [28], Tan and Floros [35], Gupta and Yesmin [29], Das Gupta, et al. [36].
Risk - Stability	Z-Score	Z-score= $(\frac{(CAR+ROA}{\delta(ROA)})$, Where ROA = Return on assets (in %); CAR = Capital adequacy ratio (in %). SD of ROA is measured through three years of moving SD.	Gupta and Moudud-Ul-Huq [37], Abedifar, et al. [38].
Profitability	ROA	Return on assets	Annual reports of respective banks. Gupta and Yesmin [29], Javaid [39], Deelchand and Padgett [40].
	ROE	Return on equity	Annual reports of respective banks. [41][42].
	PBT	Profit before tax	Annual reports of respective banks.
Efficiency-Cost	EFF_cost	Inefficiency of cost measured through SFA	Altunbas, et al. [43], Gupta and Yesmin [29], Gupta, et al. [32], Tan and Floros [35].
Efficiency-	EFF_Rev	Inefficiency of cost measured	Authors Calculation using SFA

Revenue		through SFA	
Efficiency-Human Capital	EFF_HC	Inefficiency of cost measured through SFA	Zheng, et al. [7], Gupta and Yesmin [29], Gupta [9].
Independent Variables:			
Dummy - COVID	Dummy-COVID	Dummy period 1 = 2020& 2021 0 = otherwise	Authors' Calculation
Size	Size	Logarithm of total assets	Das Gupta, et al. [36], Bougatef and Mgadmi [44].
Capital	Capital	Total eligible capital to Total assets	Gupta and Akter [45], Gupta and Yesmin [29].
LIQUIDITY	Liquidity	Loan & Advances to total deposit.	Soedarmono, et al. [46], Zheng, et al. [7].
Off Balance sheet exposure	OFBSTA	Total off balance sheet exposure to total assets	Gupta and Akter [45], Bougatef and Mgadmi [44], Mongid, et al. [47].
Revenue diversification	RD	Noninterest revenue to total revenue	Chaibi and Ftiti [28], Gupta and Akter [45].
GOVS	GOVS	Investment in Government securities	Gupta [9], Zheng, et al. [7].
Market Competition	BI	BOONE Indicator: Competition Proxy. $\pi_{it} = \alpha + \beta \ln(MC_{it})$ Where, β denotes the Boone Indicator.	Measured by Authors Gupta and Moudud-Ul-Huq [37], Das Gupta, et al. [36].
Macroeconomic variables:			
Growth of gross domestic product	GGDP	The growth of real gross domestic product.	Data source: World Bank data. (web:http://databank.worldbank.org) Das Gupta, et al. [36], Moudud-Ul-Huq [48].
Inflation	Inflation	Inflation, GDP deflator (annual %)	Data source: World Bank data. (web:http://databank.worldbank.org) Das Gupta, et al. [36], Moudud-Ul-Huq [48].

3.3. Empirical research framework

To address the impact of COVID on performance through risk, profitability, and efficiency of commercial banks in Bangladesh, we opt for the System Generalized Method of Moments (GMM). The COVID period is addressed through the Dummy Variable denoted by Dummy-COVID.

The study opts for risk, profitability, and efficiency measures to measure the performance of banks. The study will use SFA in determining efficiency as used by Altunbas, et al. [43], Kwan and Eisenbeis [49], Girardone, et al. [50], and Nițoi and Spulbar [51]. The proposed empirical model of the study to delve into the effect of COVID-19 on risk, profitability, and efficiency can be given as follows:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 \ Dummy - Covid + \ \sum_{k=3}^{4} \beta_k \ X_{i,k,t} + \sum_{n=5,8,13}^{7,12,15} \beta_l \ X_{i,n,t} + \varepsilon_{i,t} \quad (4)$$

Where $Y_{i,t}$ represents the dependent variable (Risk, profitability, efficiency). The study addresses cost, revenue, and human capital efficiency for the study measured through SFA. The subscript 'i' and 't' denotes the cross-sectional dimension and time dimension among banks. $Y_{i,t-1}$ refers to 1 year lag period of the dependent variable.

Risk refers to the credit risk measured through non-performing loans to total loans, and stability risk measured through Z-Score (Ratio between a bank's return on assets plus equity capital/total assets and the standard deviation of the return on assets). The $X_{j,k,}$ and t refer to macroeconomic variables, such as growth of gross domestic product (GGDP) and inflation (Inf). The $X_{i,n,t}$ symbolizes the bank level and other control variables of bank 'i' at '*t*' period. Subscript n = 5 to 7 denotes the bank level control variables size, liquidity, and capital for risk equation; n= 8 to 12 refers to bank control variables GOVS, size, capital, revenue diversification (RD), and industry level variable Boone Indicator (BI) for profitability equation; and Off-Balance Sheet Exposure to Total Assets (OBSTA), Return On Assets (ROA), market competition (BI) measures refers control variable of efficiency equation denoted by subscript n=13 to 15. Boone Indicator (BI) is the proxy measure of market competition.

This study opted for unbalanced panel data of 44 Bangladeshi commercial banks from 2014 to 2021 to have maximum degrees of freedom [29][32]. Following Arellano and Bover [52] and Blundell and Bond [53], system GMM is applied for unbalanced dynamic panel data. System GMM addresses the model's endogeneity, heteroskedasticity, and autocorrelation problem (see Appendix B).

Cross-sectional and time series data constitute the panel data. Using panel data can pose severe econometric challenges because the lag of the dependent variables is included as a lagged endogenous and independent variable to capture the influence of rigidity. Applying OLS (Ordinary Least Square) results in dynamic panel bias because lagged dependent variables are associated with fixed effects in the error terms. As a result, it is ineffective at addressing unobserved heterogeneity [54]. The dynamic panel bias can be solved by incorporating the least-square dummy variables [55]. However, the LSDV method is only satisfactory for balanced panel data and does not consider the endogeneity problem of other regressors. First Difference GMM (Generalized Methods of Moments) estimations of Arellano and Bond [56] can improve the lagged dependent variables' fixed effect association issues. However, it cannot fix the endogeneity problem [57][58]. Anderson and Hsiao (1981) proposed using an instrumental variable technique to optimize the dynamic panel data model's estimation accuracy. However, this method underperforms and is inefficient due to its inability to address all moment conditions even though the estimates are reliable [57][59]. Arellano and Bond [56] research work was further expanded upon by Arellano and Bover [52], as well as Blundell and Bond [60], who proposed a two-step system GMM, which makes the instruments exogenous through differencing.

Due to heteroscedasticity (White test for heteroscedasticity) and autocorrelation (Breusch-Godfrey LM test for autocorrelation), the results of the pre-diagnostic tests advise not to employ OLS as a regression method. Hausman specification tests advocate the use of the fixed-effect model. The lagged dependent variables in equation (1) reject the assumption of OLS and restrict the use of the fixed effect model and first-step difference GMM following the decisional procedures suggested by Roodman [57]. As a result, we choose to apply the two-step system GMM estimation technique of Arellano and Bover [52] and Blundell and Bond [60] for unbiased and consistent results to address the unobserved heterogeneity and endogeneity issue of unbalanced panel data.

Finally, two standard tests, Arellano and Bond (1 and 2) test and the Hansen test, are applied to check the validity of the underlying model. To second-order correlation, AR (2) examined the null hypothesis that error terms are not serially correlated. The P values of AR(2) exhibit no second-order serial correlation in all of our applied models, which is in line with Alvi, et al. [58], Naceur and Kandil [61], Rakshit and Bardhan [62] among others.

3.4. Empirical findings of study one

To run the appropriate regression model, a diagnosis of data is necessary. This section demonstrates the diagnosis test for selecting a regression model and explains the nature of the data first. Then, it represents the empirical finding of the GMM estimators.

3.4.1. Descriptive statistics, multicollinearity, and unit root tests:

3.4.1.1. Descriptive statistics

Table 2 presents the descriptive statistics of the study. The mean risk measures for NPLTL and Z-score are 0.0859 and 140.2935, respectively. The minimum value of NPLTL is 0, which means that banks have no non-performing loans. Also, the maximum value of 0.60 refers to banks with a heavy default risk of about 60% of their total loans. Another dependent variable, profitability, is measured through three measures: ROA, ROE, and Pre-tax profit. Their average values are 0.7240, 4.3108, and 1694.7590, respectively. The standard deviation of pre-tax profit is 1961.73(app). This is because few observations show a negative profit, especially government commercial banks, besides large profit-making banks. For example, we observe -14954.57 million BDT. of Basic Bank limited pre-tax profit in 2016 and a maximum pre-tax profit of 14409.60 million BDT achieved by Islami Bank Bangladesh Limited in 2019. However, these are not outliers. Those banks and other banks have consecutive figures consistent with these figures. As the maximum and minimum values deviate largely from each other, a large value of SD is feasible. Mean values of efficiencies are 1.1956, 0.8132, and 1.9386 of cost, revenue, and human capital, respectively. The average value of capital is 0.10, which denotes that, on average, 10% of banking industry assets are financed from the eligible capital of banks.

Table 2. Descriptive statistics of the study (all figures in BDT. Million except ratios and efficiencies)

Variable	Observations	Mean	SD	Min	Max
NPLTL	350	0.0859	0.1131	0.00	0.60
Z-score	350	140.2935	49.1067	-20.87	646.47
ROA	350	0.7240	1.0119	-7.49	4.48
ROE	350	4.3108	17.2732	-23.04	69.51
Pre-tax Profit	350	3125.31	2958.696	-14954.57	14409.62
Efficiency-Cost	350	1.1956	0.1335	0.73	1.74
Efficiency-Revenue	350	0.8132	0.1148	0.41	1.94
Efficiency-Human Capital	350	1.9386	0.5264	1.02	3.76
Size	350	12.1900	1.0289	8.51	14.35
Dummy -COVID	350	0.2514	0.4345	0.00	1.00
Capital	350	0.1007	0.0742	-0.15	0.81
Liquidity	350	0.8616	0.1684	0.37	2.62
OFBSTA	350	0.2478	0.1462	0.00	0.93
RD	350	26.6171	11.8641	1.76	66.72
Boone Indicator (BI)	350	-3.9501	3.0831	-8.60	-0.08
GGDP	350	6.4892	1.2635	3.45	7.88
Inflation	350	7.7444	7.6813	3.66	27.85
GOVS	350	44024.96	74859.98	0.55	614399.00

Investment in government securities also shows a very large standard deviation, such as pre-tax profit. This is also because of greater variability in minimum to maximum values. The average value of the industry-level variable Boone Indicator is -3.95. As Boone Indicators' usual expression is negative, it is feasible by nature. The mean GGDP and Inflation of

Bangladesh are 6.4892 and 7.744, respectively. GGDP shows that Bangladesh's economic growth rate is better than that of the average Asian market [32]. The average inflation value is 7.74, which is the cumulative effect of previous years. Bangladesh faced a very high inflation rate in 2016, which was about 26 %. However, the current inflation rate of Bangladesh is about 4.12 (in 2021), which is better than neighboring country India (9.97 in 2021) and economic giant China (4.31 in 2021) [source: https://databank.worldbank.org/source/world-development-indicators]. The mean values of other bank-level control variables, liquidity, off-balance sheet exposures, and revenue diversifications are 0.86, 0.25, and 26.61 (app), respectively.

To select the appropriate econometric model and data fitness, we perform a pairwise correlation matrix and variance inflation factor (VIF) test (results will be available on request upon the authors). We observe no severe multicollinearity problem and unit root in the data set.

3.4.2. Risk equation examining the impact of COVID on performance

Table 3 explains the impact of COVID period on the risk of commercial banks in Bangladesh. There are two measures of risk. These are Credit risk addressed through Non-performing loans to total loans and advances and Stability risk measured through Z-score. Z-score refers to the stability of banks and a measure of default risk. The lag-dependent variables are significant, indicating that commercial banks' risks are persistently determined from year to year. The COVID period was addressed through a dummy variable depicting a significant positive association with credit risk and a negative association with stability. It means that in the COVID period, banks' risk increases and stability decreases compared to the normal period. It demonstrates that the COVID period significantly impacted the risk and stability of commercial banks in Bangladesh. Banks' risk is substantially less in the pre-COVID period than in the new normal situation. Stability also depicts the reserve situation of risk finding in pre-COVID and COVID periods.

Table 3. Impact of COVID on the risk of commercial banks

	Risk -NPLTL	Risk-Z-score
Risk-NPLTL(-1)	0.8827***(74.33)	
Risk- Z-score(-1)		0.1001**(2.09)
Dummy_COVID	0.0103***(3.36)	-105.2635***(-5.04)
Size	-0.0055***(-3.46)	46.4012***(3.66)
Capital	-0.1261***(-3.64)	458.8887***(3.41)
Liquidity	-0.0357***(-3.79)	-150.9671(-1.55)
GGDP	0.0064***(7.81)	1.1720(0.38)
Inflation	-0.0001(-0.50)	0.7501(0.58)
Constant	0.0757***(2.92)	-340.6681**(-2.08)
Hansen Test (P-value)	0.627	0.764
AR(1) (P-value)	0.054	0.026
AR(2) (P-value)	0.515	0.315
Observations	306	306

*Note: *, **, and *** refer to significance at 0.10 percent, 0.05 percent, and 0.01 percent levels, respectively. t-value are reported in parenthesis. The dependent variable is NPLTL denotes the proxy measure of risk, and the Z-score is the proxy measure of stability. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano–Bond order 1 (2) are tests for first (second) order correlation, asymptotically N (0, 1). These tests the first-differenced residuals in the system GMM estimation.*

Size is negatively (positively) associated with commercial banks' risk (stability). It illustrates that banks with good asset sizes manage risk and stability more than their small

asset-size counterparts. Capital is negatively related to risk and positively related to stability. These findings postulate the relevance of using regulatory capital in managing risk and enhancing stability. It also demonstrates that capitalized banks are doing well in managing risk. Inversely, it can also be said that low-capitalized banks are taking more risk than their capitalized counterparts. Liquidity is negatively related to risk. It assumes that with the increase of liquidity, both banks' risk-taking tendency and stability enhance. The macroeconomic variable GGDP shows a positive association with the risk and stability of banks. This means that with the economic progression, both risk-taking and bank stability will increase. This is because, in economic advancement, trade and businesses are usually growing, which increases the demand for loans and advances to banks. That, in turn, increases the risk-taking of banks. However, with economic progress, client loan servicing become easier than usual. That is why risk and stability both increase at higher GGDP. Another macroeconomic inflation shows a negative association with risk and a positive association with stability. It denotes that during an inflationary period, the risk of banks increases and stability decreases.

3.4.3. Profit equation examining the impact of COVID on the profitability of banks

This study opts for three measures of profitability. These measures are return on assets (ROA), return on equity (ROE), and profit before tax (pre-tax profit). Empirical findings of all the measures of profitability are consistent and similar.

Table 4. Impact of COVID on the profitability of commercial banks.

	Profitability ROA	Profitability ROE	Profitability Pre-tax profit
Profitability-ROA(-1)	0.1879**(2.10)		
Profitability-ROE(-1)		0.3162***(58.10)	
Profitability-PBT(-1)			0.38744**(2.68)
Dummy_COVID	-0.3726***(-3.35)	-6.4194(-1.03)	-590.588*(-1.91)
GOVS	-3.46E-06***(-3.47)	-0.0001(-0.72)	-0.00764**(-2.25)
Size	0.2925***(3.52)	25.8470***(3.89)	1639.536***(3.32)
Capital	9.3606***(3.56)	511.9719***(5.68)	10154.22**(2.12)
RD	0.0188***(3.24)	-0.1399(-0.23)	14.81903(1.22)
BI	0.0420***(3.28)	-0.1023(-0.25)	36.44211(1.62)
GGDP	-0.024*(-1.92)	-1.9774**(-2.27)	-13.336(-0.21)
Inflation	0.0088*(1.99)	0.1837**(2.41)	-0.56043(-0.07)
Constant	-3.87***(-3.64)	-339.5756***(-3.49)	-18620.4***(-3.26)
Hansen Test (P-value)	0.227	0.425	0.945
AR(1) (P-value)	0.084	0.278	0.103
AR(2) (P-value)	0.327	0.334	0.458
Observations	306	306	306

*Note: *, **, and *** refer to significance at 0.10 percent, 0.05 percent, and 0.01 percent levels, respectively. t-value are reported in parenthesis. The dependent variable is profitability measured through ROA, ROE, and Pre-tax profit. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano–Bond order 1 (2) are tests for first (second) order correlation, asymptotically N (0, 1). These tests the first-differenced residuals in the system GMM estimation.*

Table 4 shows Lag-dependent variables are significant and positively associated with profitability. It means that last year's profits have significantly affected current-year profits. The dummy variable shows a significant negative association with profitability. It means that the profitability of commercial banks in Bangladesh was influenced considerably by COVID. Pre-tax profit and return on assets of banks decreased in the pre-COVID period. That means the COVID period inversely affects the profitability of banks. The negative association of the dummy variable demonstrates that during COVID-19, banks' profitability decreased significantly more than in other periods. Investment in government securities reduces banks' profitability, signified by the negative coefficient of GOVS. Large banks gaining more profit are denoted by the positive coefficients of size. The positive association of capital with profitability explains that capitalized banks gain more profit than their low-capitalized counterparts. This advocates that regulatory capital manages risk and enhances banks' profitability. Diversification of revenue act incremental impact on profitability denoted by the positive coefficient of RD. This finding supports the portfolio investment. Market competition measure (BI) shows a positive association with profitability. As BI usually bears a negative sign, it refers to inverse meaning in explaining the relationship with the dependent variable. That means in the competitive market, banks are gaining less profit than average. In economic progression, banks are gaining less profit, denoted by the negative association of GGDP. This is because, in economic progression, commercial banks of Bangladesh usually follow an expansionary policy by reducing the interest rate of loans and advances [45]. A positive association with inflation signifies that the return on assets and equity increases during the inflationary period.

3.4.4. Efficiency equation examining the impact of COVID on the efficiency of banks

This study opts for three efficiency measures to address the impact of COVID. These are cost, revenue, and human capital efficiency. We use SFA to determine banks' efficiency.

Table 5. Impact of COVID on the efficiency of banks

	Efficiency Revenue	Efficiency Cost	Efficiency Human Capital
EFF_rev (-1)	1.086226***(968.46)		
EFF_cost (-1)		0.9594***(3761.16)	
EFF_HC (-1)			1.0637***(894.07)
Dummy_COVID	0.000416***(5.77)	5.84E-08(0.0076)	0.00091***(3.58)
Risk (NPLTL)	0.005856***(5.18)	-0.0013***(-4.49)	0.0097**(2.28)
ROA	-1.30E-04**(-2.24)	-6.9E-05***(-5.03)	0.00042**(2.22)
OFBSTA	-0.00083**(-2.61)	-0.00024(-1.39)	0.0055***(3.54)
BI	8.02E-06(1.32)	-3.32E-06(-1.60)	5.08E-05***(2.79)
GGDP	5.14E-05***(3.96)	5.39E-06(1.42)	8.58E-05*(1.91)
Inflation	3.94E-07(0.28)	-4.48E-07(-0.78)	-8.91E-06(-1.53)
Constant	-0.0882***(-98.06)	0.0414***(134.22)	-0.07398***(-33.07)
Hansen Test (P-value)	0.967	0.245	0.471
AR(1) (P-value)	0.104	0.364	0.100
AR(2) (P-value)	0.100	0.968	0.437
Observations	305	305	305

*Note: *, **, and *** refer to significance at 0.10 percent, 0.05 percent, and 0.01 percent levels, respectively. t-value are reported in parenthesis. Dependent variable is Efficiency measured through SFA. We address three measures of efficiency. These are Cost, Revenue, and Human Capital. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano–Bond order 1 (2) are tests for first (second) order correlation, asymptotically N (0, 1). These tests the first-differenced residuals in the system GMM estimation.*

Lagged dependent variables are positive and significant, referring that efficiencies being persistently determined. Although cost efficiency has no impact on COVID, revenue and human capital efficiencies have been positively affected by COVID. Although COVID period negatively affects the risk and profitability of banks, it is positively associated with banks' revenue and human capital efficiency. Surprisingly, the efficiency of banks increased significantly during the COVID period compared to pre-COVID periods. It signifies that in the COVID period, revenue trade-off with cost and cost per employee was efficiently utilized. The coefficient of credit risk (NPLTL) refers to incremental credit risk that deteriorates cost efficiency but enhances banks' revenue and human capital efficiency. This finding of cost efficiency is in line with the finding of Isshaq, et al. [63]. Again, the positive association of NPLTL with human capital efficiency means that incremental credit positively affects human capital performance, i.e., human capital acts more efficiently when banks' credit risk increases. These findings are in line with Gupta [9]. Proportionate reduction of loan monitoring costs is one of the possible reasons for increased revenue and human capital efficiency with enhancing credit risk [35]. The negative association of ROA with efficiency means that banks with low-rate profits are more cost and revenue-efficient; however, profitable banks possess more efficient human capital. These findings are similar to the results of Zheng, et al. [10]. The coefficient of off-balance sheet exposure depicts a negative (positive) association with cost (human capital) efficiency. Market competition has found no significant impact on efficiency except human capital. BI of human capital efficiency refers to the fact that in a competitive market, the human capital efficiency of commercial banks reduces. This finding supports the previous results of Gupta [9]. In economic progress, the efficiency of banks increases, explained by the coefficient of GGDP.

4. Study two-determining the determinants for post-COVID performance

This study encompasses the determinants of post-COVID performance of commercial banks in Bangladesh. Conceptual frame work of the study is presented in Figure 1.

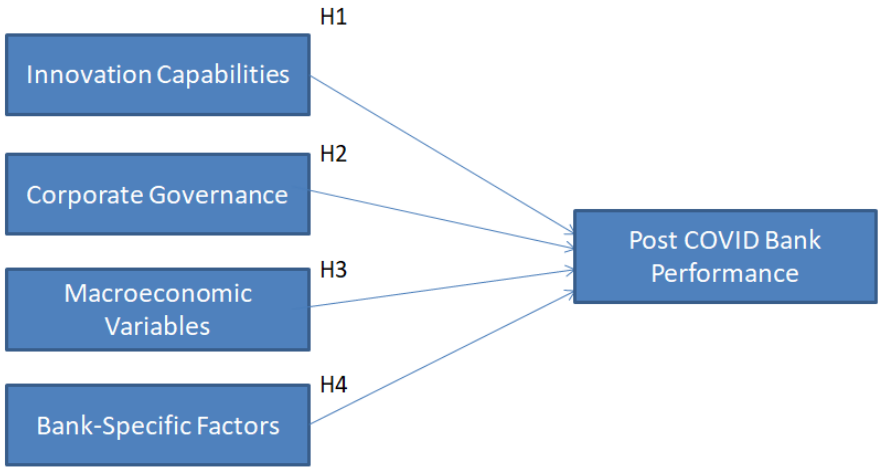

Figure 1. Conceptual framework

4.1. Hypotheses development

4.1.1. Innovation capability

The COVID-19 pandemic has presented numerous business difficulties [64][65]. Hence, in the wake of the COVID-19 pandemic, it is imperative for firms to introduce innovation into their operations. In a recent empirical investigation within the tourism sector, Wijaya and Rahmayanti [66] found that innovation capacity had a notable and favorable influence on the firm's business performance. Kien and That [67] argued that in the aftermath of COVID-19, innovation is widely recognized as a critical element for enhancing organizational efficiency and gaining a competitive edge. Further, they contended that as banks transition to the next stage of addressing COVID-19, they must devise creative strategies to promote sustainable growth. Hence, in the aftermath of the COVID-19 pandemic, firms should engage in innovative practices within their operations. Thus, we postulate that.

H_{21}: Innovation Capability significantly influences the performance of banks at post-COVID-19.

4.1.2. Corporate Governance

Corporate governance can be formally defined as the framework within an organization, encompassing a hierarchical system of authority, motivation mechanisms, established operational protocols, and documented methods for addressing conflicts [68]. Typically, it relies on managerial control principles [69]. However, Peni and Vähämaa [70] discovered the effects of corporate governance on bank performance during the financial crisis are mixed. For example, in 2008, banks with more robust corporate governance systems experienced greater profitability, and effective corporate governance did not generate shareholder value in the banking sector amidst the market turmoil [70]. The bank's corporate governance framework is of utmost importance for the success of the bank and its day-to-day functioning [71]. However, considering the two indicators (board members and ownership) of corporate governance, Paniagua, et al. [72] revealed that corporate governance has no significant influence on the firm performance. Therefore, the hypothesis is as follows:

H_{22}: Corporate governance significantly influences the performance of banks at post-COVID-19.

4.1.3. Macroeconomic variables

The operational and performance of banks can be influenced by macroeconomic factors that fall outside the realm of management's control. Macroeconomic variables such as inflation and exchange rate have conflicting impacts on bank performance [67]. Numerous researchers have asserted that inflation has an adverse impact on the performance of banks [73][74][75]. On the contrary, several researchers proposed the exact opposite outcome [76][77]. On the other, regarding exchange rates, empirical research yielded contradictory results [67]. For instance, while Lagat and Nyandema [78], and Hasanov, et al. [79] reported a negative relationship, Ghurtskaia [80] exact opposite relationship. However, Kien and That [67] reported that macroeconomic factors exhibit a statistically significant adverse impact on the performance of banks. Therefore, since macroeconomic variables such as inflation and exchange rate invade or enhance bank performance, the study proposes the following hypothesis:

H_{23}: Macroeconomic variables have a significant effect on bank performance.

4.1.4. Bank-specific factors

Bank-specific factors refer to the variables within the internal environment of banks that they can control for their advantage, and these factors vary from one bank to another. Bushashe [81] considered liquidity, bank size, operating efficiency, asset quality, and capital adequacy as the important bank-specific factors that influence bank performance. Conversely, Ariyibi, et al. [82] considered asset quality, the loan-to-deposit ratio, board size, and capital adequacy as significant internal factors that impact a bank's performance. However, empirical results indicate that liquidity has positive and negative effects on bank performance. On the other, studies also disclosed that bank size adversely [83][84] and positively [85][86] influences the bank's profitability. Operational efficiency (OE) assesses the extent to which management effectively manages expenses. Earlier studies demonstrated a significant adverse influence of operational efficiency on profitability [87]. However, investigations revealed that asset quality influence bank performance deleteriously [88]. Nevertheless, there is a positive correlation between capital adequacy and profitability [85][89]. Further, the study of Bushashe [81] indicates that a rise in bank-specific factors (liquidity, bank size, operational efficiency, asset quality, and capital adequacy) results in an improvement in bank performance. Considering the theoretical and empirical reasoning presented thus far, it leads to the formulation of the following hypothesis.

H_{24}: Bank-specific factors exhibit a significant impact on the performance of banks.

4.1.5. Industry-specific factors

The composition of the banking sector also significantly influences a bank's potential earnings. Prior research has explored the significance of concentration ratios and market share as pivotal elements in the configuration of the banking industry [81][90].

They contended that a positive correlation exists between concentration ratios [81][84] and market share and a bank's profitability [90]. Conversely, Staikouras, et al. [91], Athanasoglou, et al. [92], and Alfadli and Rjoub [85] discovered a statistically inconsequential impact. Further, Bushashe [81] portrayed that factors unique to the banking industry exhibit a statistically significant adverse effect on bank performance. Therefore, the study formulated the following hypothesis based on the rationale above.

H_{25}: Industry-specific factors have a significant effect on bank performance.

4.2. Research methodology study two

4.2.1. Data collection and sampling method

Considering the knowledge level of the banking system, bank employees, especially the middle and senior management of banks as well as experts of the financial market, were targeted as the participants of this study. A questionnaire was developed using Google Forms. The Google form's link was sent to potential participants via email and other social media platforms such as LinkedIn, WhatsApp, Messenger, and others. We received very few responses at the beginning. Later, we contacted the respondents over the phone and social media and requested them to reply to the questionnaire. And finally received 174 responses. Seven responses were excluded from the pool because of incomplete responses and outliers problems and 167 cases. Nevertheless, the G*Power software calculated that a minimum sample size of 89 would be required in order to attain a statistical power of 95%, considering the presence of five exogenous constructs and a significance level of 0.05. Hence, the study's

sample size of 167, obtained from the distributed questionnaire's link, is deemed adequate for this research.

4.2.2. Measures

Measurements of instruments were developed based on the extensive literature review. The measurements of two constructs, namely- Innovation Capabilities, were adapted from Chi [64] and Migdadi [93], and - Corporate Governance was adapted from Black, et al. [94] and Tachizawa and Wong [95]. This study developed five statements for measuring Bank-specific Factors, three for Industry-specific Factors, three for macroeconomic factors, and four for Bank Performance through a rigorous literature review. Before finalizing the questionnaire for data collection, this study performed reliability and validity tests on Bank-specific Factors, Industry-specific Factors, macroeconomic factors, and Bank Performance to ensure that the statements effectively encapsulate the concepts upon which generalizations will be based. However, the study obtained Cronbach's Alpha value 0.813 for 5 items of Bank-specific Factors, 0.873 for Industry-specific Factors. On the other hand, with three items, macroeconomic factors did not produce an acceptable Cronbach's alpha value. After deleting one item (MEF3 with low Cronbach's Alpha value 0.357) from the three, Macro-economic Factors generated a Cronbach's Alpha value 0.788. Regarding the Bank Performance, with four items, a low Cronbach's Alpha value was observed. The construct Bank Performance surpass the threshold of Cronbach's Alpha value 0.70 after deleting the item BP4.

4.3. Data analysis and results

The present study aims to forecast the primary target construct and examine novel hypotheses. As a result, Partial Least Squares (PLS) was chosen to assess the model due to its capacity to provide the necessary features. PLS path modeling, as a variance-based Structural Equation Modeling (SEM) approach, finds widespread application in both business and social sciences. Its capacity to effectively model composites and factors has rendered it a powerful statistical tool [96]. The PLS path model definition encompasses two sets of linear equations: the measurement model and the structural model. The measurement model delineates the relationships between a construct and its observed indicators, while the structural model delineates the interactions between the constructs [96][97]. PLS required fewer prerequisites compared to covariance structure analyses [98]. For instance, first, PLS eases the assumptions related to normality and outliers. Second, it enables the evaluation of relationships between latent variables with multiple indicators, even when dealing with a limited sample size. Third, it can be readily employed to model hierarchical constructs at various levels of abstraction [97]. Furthermore, SmartPLS 3 is designed to enhance the explained variance of all exogenous constructs while also facilitating the pursuit of prediction-oriented objectives [99]. Therefore, recognizing the benefits provided by PLS, especially for this study, the paper utilized SmartPLS 4.0 as the technical software for PLS-SEM.

4.3.1. Descriptive analysis

The demographic characteristics of the respondents are outlined in Table 6, where 46.10% of the participants were with banking experience between 11 to 20 years, and 44.91% were with more than 20 years. The majority fall within the age range of 31 to 50, and all the respondents are highly educated.

Table 6. Participants' demographic characteristics

Dimensions	Frequency	Percentage	Dimensions	Frequency	Percentage
Gender			Education		
Female	47	28.14	Honors	03	1.80
Male	120	71.86	Masters	160	95.80
Age (years)			PhD	04	2.40
25-30	07	4.20	Experience in Banking Sector		
31-40	28	16.76	< 10 years	15	8.99
41-50	87	52.09	11-20 years	77	46.10
50-60	45	26.95	>20 years	75	44.91

4.3.1. Common method bias (CMB)

CMB can be observed when the data relies on self-reporting [100]. Further, CMB becomes an issue when the survey data is gathered from a solitary informant [101]. Following the suggestion of Bagozzi, et al. [102], to assess CMB, we employed two techniques: Harman's single-factor test and the correlation matrix. In the Harman single-factor test, conducted using principal axis factoring with an unrotated factor solution, it was evident that a single factor explained 33.90% of the variance, significantly lower than the recommended threshold of 50% [103]. Further, the analysis revealed that no correlation is greater than 0.90 [102]. Thus, the presence of CMB was not a significant concern in this study.

4.3.2. Measurement model specification

The study assessed the measurement model's adequacy by examining internal reliability (IR), Convergent Validity (CV), and Discriminant Validity (DV). To assess internal reliability, Cronbach's alpha (α) and composite reliability were examined. It was observed that Cronbach's alpha ranged from 0.708 to 0.863 (Table 7), and composite reliability ranged from 0.710 to 0.914 for rho_A and 0.857 to 0.901 (Table 7). These values, all exceeding the recommended threshold of 0.70, indicate adequate internal consistency [104]. Factor loadings and the average variance extracted (AVE) were scrutinized to evaluate CV. Table 16 also specifies that all factor loadings are above 0.7, and the AVE for each construct surpassed 0.50, indicating that the desired level of CV has been attained [105]. DV was examined using the Heterotrait-Monotrait (HTMT) ratio of correlations (Henseler et al., 2015), Fornell-Larcker criterion, and indicators' cross loadings. Table 8 illustrates that the HTMT ratios are below 1.0 [96]. In the Fornell-Larcker criterion in Table 9, the square root of the AVE along the diagonal are higher than the correlation coefficients (off-diagonal) between the constructs to their relevant rows and columns [105]. Further, Table 10 exhibits that all indicators were loaded to their corresponding constructs. The provided evidence, thus, affirms the IR, CV, and DV of the measures.

Table 7. Loading, composite reliability, Dijkstra Henseler and average variance extracted

Construct	Items	Loadings	VIF	CA	rho_A	rho_C	AVE
Bank Performance	BF1	0.833	1.588	0.749	0.750	0.857	0.666
	BF2	0.834	1.585				
	BF3	0.780	1.384				
Bank-Specific Factors	BSF1	0.763	1.674	0.863	0.869	0.901	0.646
	BSF2	0.784	1.885				
	BSF3	0.819	2.090				
	BSF4	0.848	2.210				
	BSF5	0.801	1.839				

Corporate Governance	CG1	0.823	1.915	0.847	0.862	0.896	0.684
	CG2	0.776	1.712				
	CG3	0.871	2.106				
	CG4	0.837	1.900				
Innovation Capabilities	IC1	0.770	1.666	0.826	0.914	0.887	0.725
	IC2	0.795	1.744				
	IC3	0.770	1.876				
	IC4	0.720	1.635				
	IC5	0.813	1.746				
Industry-Specific Factors	ISF1	0.905	1.855	0.835	0.851	0.882	0.600
	ISF2	0.861	1.811				
	ISF3	0.783	1.970				
Macroeconomic Variables	MEV1	0.873	1.430	0.708	0.710	0.873	0.774
	MEV2	0.886	1.430				

Table 8. Heterotrait-monotrait ratio (HTNT)-Matrix

	BF	BsF	CG	IsF	IC	MEV
Bank Performance						
BankSpecific Factors	0.725					
Corporate Governance	0.684	0.613				
IndustrySpecific Factors	0.230	0.275	0.214			
Innovation Capabilities	0.614	0.605	0.572	0.142		
Macroeconomic Variables	0.456	0.343	0.405	0.246	0.289	

Table 9. Fornell-Larcker criterion

	BF	BsF	CG	IsF	IC	MEV
Bank Performance	0.816					
Bank-Specific Factors	0.588	0.804				
Corporate Governance	0.552	0.530	0.827			
Industry-Specific Factors	0.208	0.247	0.189	0.851		
Innovation Capabilities	0.500	0.518	0.483	0.126	0.774	
Macroeconomic Variables	0.332	0.273	0.316	0.189	0.224	0.880

Table 10. Cross loading

	Bank Performance	BankSpecific Factors	Corporate Governance	IndustrySpecific Factors	Innovation Capabilities	Macroeconomic Variables
BF1	0.833	0.488	0.460	0.170	0.408	0.277
BF2	0.834	0.501	0.445	0.137	0.449	0.267
BF3	0.780	0.450	0.447	0.204	0.365	0.269
BSF1	0.448	0.763	0.336	0.111	0.364	0.150
BSF2	0.421	0.784	0.447	0.098	0.382	0.193
BSF3	0.428	0.819	0.442	0.205	0.430	0.199
BSF4	0.540	0.848	0.462	0.258	0.529	0.263
BSF5	0.507	0.801	0.440	0.294	0.362	0.275
CG1	0.420	0.405	0.823	0.150	0.375	0.223
CG2	0.371	0.371	0.776	0.209	0.427	0.236
CG3	0.531	0.493	0.871	0.159	0.441	0.276
CG4	0.480	0.469	0.837	0.122	0.360	0.303
IC1	0.390	0.333	0.425	0.103	0.770	0.223
IC2	0.414	0.436	0.399	0.075	0.795	0.264
IC3	0.307	0.424	0.333	0.111	0.770	0.191
IC4	0.299	0.377	0.333	0.110	0.720	0.064
IC5	0.477	0.435	0.370	0.098	0.813	0.117

ISF1	0.219	0.200	0.173	0.905	0.136	0.139
ISF2	0.177	0.254	0.180	0.861	0.091	0.206
ISF3	0.069	0.164	0.100	0.783	0.074	0.141
MEV1	0.284	0.218	0.277	0.176	0.222	0.873
MEV2	0.299	0.261	0.279	0.157	0.174	0.886

4.3.4. Inspecting the inner structural model and hypotheses testing

To examine the hypothesized relationships, the bootstrapping method was employed in SmartPLS 4.0, with a resample size of 5000 as recommended by Hair et al., [97]. The significance level for testing these relationships was set at 0.05 ($p < 0.05$), following the methodology proposed by Efron and Tibshirani [106]. The results in Table 11 revealed that Bank-Specific Factors ($t = 3.828$, $\beta = 0.309$, $p < .001$), Corporate Governance ($t = 3.151$, $\beta = 0.235$, $p < .01$), Innovation Capabilities ($t = 2.399$, $\beta = 0.207$, $p < .05$), and Macroeconomic Variables ($t = 2.021$, $\beta = 0.098$, $p < .05$) have significant relationships with Bank Performance. However, the interactions between Industry-Specific Factors ($t = 0.511$, $\beta = 0.056$, $p > .05$) and Bank Performance were not supported.

Table 11. Testing the hypothesis in the structural model

Hypothesis	Relationship	Std Beta	Std error	t-value	P-values	Decision
H21	BankSpecific Factors -> Bank Performance	0.309	0.081	3.828	0.000	supported
H22	Corporate Governance -> Bank Performance	0.235	0.075	3.151	0.002	supported
H23	IndustrySpecific Factors -> Bank Performance	0.056	0.078	0.511	0.609	Not supported
H24	Innovation Capabilities -> Bank Performance	0.207	0.084	2.399	0.016	supported
H25	Macroeconomic Variables -> Bank Performance	0.098	0.049	2.021	0.043	supported

R2 = 0.546
t-value >= 1.96 at p = 0.05 level, t-value >= 2.58 at p = 0.01 level, t-value >= 3.29 at p = 0.001 level

4.3.5. R2 and model fit

Table 11 also indicates the percentage of variance explained in the bank performance with R2. An R2 value of 0.25 in the inner structural model suggests a weak model, while an R2 value of 0.50 indicates a moderate model and an R2 value of 0.75 signifies a strong model for the endogenous construct. This study reveals a moderate R2 value of 0.546, signifying that the proposed conceptual model adequately accounts for a substantial portion of the variance in bank performance at post-COVID-19. Further, the model fit was also evaluated using Standardized Root Mean Square Residual (SRMR). The overall model is considered adequate, with both the saturated and estimated values measuring 0.061 and 0.063, respectively.

4.4. Discussion

The robust and positive performance of banks in the post-COVID-19 period is vital for recuperating from the losses incurred during the pandemic. Banks have employed various strategies to recover their losses. Nevertheless, there is a scarcity of studies that specify the exact factors banks need to consider for strong performance in the post-COVID-19 period. This study is an attempt to seal this gap. Therefore, drawing from an extensive literature review, this study has identified bank-specific factors, corporate governance, innovation

capabilities, macroeconomic variables, and industry-specific factors as potential key determinants of bank performance in the post-COVID-19 era.

However, the study revealed that four out of five predictors are significant and positively influence the bank performance. For instance, bank-specific factors (liquidity, bank size, operating efficiency, asset quality, and capital adequacy) have the most significant positive influence on post-COVID bank performance. This finding is consistent with the findings of Alfadli and Rjoub [85], Isayas [86], and Bushashe [81]. Consistent with the findings of Peni and Vähämaa [70], this study has shown that corporate governance has a noteworthy positive impact on post-COVID bank performance. In addition, innovation capabilities emerge as a crucial predictor of post-COVID bank performance, exhibiting a notably positive influence. Kien and That [67] also contended the same. Macroeconomic variables such as inflation and exchange rate significantly and positively influence the post-COVID bank performance. Though the previous study recorded conflicting impacts of macroeconomic variables on bank performance. For instance, Almalki and Batayneh [73], Cetin [74], and Batayneh, et al. [75] showed that inflation and bank performance are negatively correlated, and Lagat and Nyandema [78], and Hasanov, et al. [79] showed that exchange rate and bank performance are negatively associated. In contrast, Almansour, et al. [77] and Dao and Nguyen [107] revealed that inflation and bank performance are positively connected, and Ghurtskaia [80] reported exchange rate and bank performance are positively coupled. Surprisingly, this study finds no significant effect of industry-specific factors on post-COVID bank performance, though the previous study reported a negative effect [81].

6. Conclusion

COVID-19, the most devastating pandemic, shook the world, cost lives, and economic destruction all over the world. The world witnessed not only a deadly disease but also economic destruction due to lockdowns and recession. Financial markets are no exception affected by the COVID pandemic's black paw.

This study investigates the impact of COVID-19 on the performance of commercial banks in pre-COVID and COVID periods. The study also encompasses the post-COVID determinants that significantly affect commercial banks' performance in combating post-COVID shock.

Empirical findings of the study reveal that COVID-19 has a significant effect on the risk, stability, profitability, and efficiency of commercial banks in Bangladesh. During the COVID-19 period, the risk of banks increased, stability and profitability decreased substantially compared to pre-COVID period in the banking industry. However, revenue and human capital efficiency also increased in the COVID period than in the immediate pre-COVID periods. Other factors like capital, size, and liquidity have an inverse effect on the risk of commercial banks, whereas GGDP is positively associated with the risk of banks. On the other hand, capital, size, market competition, revenue diversification, and inflation positively affect the profitability and investment in government securities, while GGDP negatively affects commercial banks' profitability. In efficiency concerns, the results are mixed. Risk enhances revenue and human capital efficiency; however, it decreases the cost efficiency of banks. A similar effect was also observed with the increase of ROA. Again, OBSTA, ROA, BI enhance human capital efficiency, whereas OBSTA and ROA negatively affect commercial banks' revenue efficiency.

Investigation of post-COVID determinants for commercial banks' performance reveals that both bank-level variables liquidity, size, efficiency, asset quality, and corporate governance;

macroeconomic variables inflation and exchange rate have a significant impact on the post-COVID performance of commercial banks, whereas there is no significant effect of the industry-specific variables on the post-COVID performance of commercial banks.

The study will contribute significantly to observing the apparent effect of COVID-19 on banks' performance and to have a guideline for future remedies to handle the post-COVID performance from the study of Bangladeshi commercial banks. This study can be further extended by observing the actual results of post-COVID performance by extending the study's data.

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