Role of financial inclusion on bank stability in Bangladesh

Mohim Uddin Chowdhury and Abu Hanifa Md Noman
Department of Business Administration
International Islamic University Chittagong (IIUC), Bangladesh

Abstract

This study investigates the role of financial inclusion on bank stability in Bangladesh. Financial inclusion indicates equality and availability of financial products to individuals and businesses, which is captured with natural logarithm of number of ATM per 100 thousand of people (*ln*ATM), log of number of bank branch (*ln*BB), ratio of Private Credit to Gross Domestic Product (PCGDP), ratio of financial system deposit to GDP (FSDGDP). Conversely, bank stability is proxied by natural logarithm of Z-score (*ln*Z-score), and ratio of non-performing loan to gross loan (NPL ratio). In the investigation process, we have used an unbalanced panel dataset consisting of all commercial banks from Bangladesh over the 2002-2014 period. Controlling a number of bank-level and macro-economic variables, the random effect model demonstrates that financial inclusion is positively related with bank solvency and negatively related credit risk taking. The results suggest that financial inclusion is supportive for promoting bank stability in Bangladesh. Therefore, the paper proposes to bolster financial innovation in order to increase financial in Bangladesh.

Keywords   Bangladesh, Bank, Bank stability, Financial inclusion, Random effect.

Paper type   Research paper

Introduction

Efficient intermediation of the banking system requires bank stability to build public trust in the system and develop well-functioning financial markets. Instability is considered as the main cause of bank failure which outbursts financial crisis with its negative spill over effect to the economy by shrinking credit facilities, distorting interbank loan market and payment system. Against the backdrop, the aftermath of the 2008-09 Global Financial Crisis, financial inclusion has become the most important public policy in order to restore bank stability and smoothen intermediation process. Because, exclusion is the main barrier of financial market development and consumer protection, and inclusion promotes savings, investment, and employment, and reduces income inequality and poverty. In recent years, with the advancement of technological innovation, and competition in the formal banking market, banks are

expanding their product bases and entering into new markets searching new opportunities. Theoretically, financial inclusion helps banks to reduce cost and risk-taking attaining economics of scale by increasing its customer base, however, empirically it is not investigated whether financial inclusion promotes bank stability. This study intends to fulfil this literature gap by investigating the role of financial inclusion on bank stability in an emerging economy.

Financial stability is a condition where financial system like financial intermediaries, market and financial infrastructure are able to perform their functions smoothly and able to enhance economic progress, manage risk and absorb shocks. The prime function of financial system is financial intermediation. It facilitates channelling the funds from it's suppliers to demanders, and facilitates firms to allocate financial resources and risk optimally across the economy which promote the economic growth and development. On the other hand, financial instability exposes an economy towards financial crisis, and restricts financial markets to perform their functions optimally. On the other hand, financial inclusion is a process which provides financial services like credit facility, saving account, payments and insurance products to the underprivileged people at an affordable price, which delivered in a sustainable way. Han and Melecky (2013) mention that financial inclusion provides saving facilities to the individuals for the future with safe place which also contributes in financial stability because bank can use this deposit in financial crisis, as a result bank are become more stable.

In investigating the effect of financial inclusion on bank stability, Bangladesh is considered as a fertile laboratory from the developing country context. There are many indications that both financial inclusion and stability are tightly connected in Bangladesh. Firstly, the banking sector is the predominated source to credit to productive units in the country belonging more than 90% of financial assets of the country due to inefficient capital market. Secondly, the adoption of agent banking services to bring 70% of rural people under the coverage of formal banking services has increased the financial inclusion coverage in Bangladesh in recent years. The financially included adults have been increased by 10% from 2017 to 2018, and become 48% of total 163 million people of Bangladesh (Bangladesh bank, 2019; Worldometers, 2019). Thirdly, the banking industry of Bangladesh has been experiencing a turbulent situation due to increase of the non-performing loan ratio from 9.2 % in 2009 to 10.7 % in June, 2017, decrease of risk weighted capital adequacy ratio from 11.9 % in 2009 to 10.1 % in June, 2017, and decrease of profitability as measured by ROA ratio from 1.4 % in 2009 to 0.34 % in June, 2017, and ROE ratio from 21.7 % in 2009 to 4.7 % in June,

2017. In order to restore bank stability, the Government of Bangladesh, and country's central bank, Bangladesh Bank have already taken many measures including recapitalization of Tk.136.6 billion to state owned banks during the 2012 to 2017 period, reduce the Cash Reserve Ratio (CRR) from 6.5 % to 5.5 % in March, 2018. However, it is not clear whether this banking instability is due to high financial inclusion in Bangladesh.

The literature gives evidence on the positive role of financial inclusion in promoting bank stability such as financial inclusion reduces the inequality and poverty in society and helps in economic growth. Financial inclusion benefits individual increasing capability to start new business through micro financing, which helps them to pay for education for children and country's economic and social development. On the other hand, the main goal of financial stability is allocation of financial resources among the people and distribution of risks across the economy which promoting the economic growth and development. In financial stability, financial system can deliver their function smoothly and financial inclusion can change the functions of financial system. It helps the people move from cash economy to banks account, improve quality and availability of the financial products and services, provides credit to small and medium firms, and reduces poverty alleviation. We can see that financial inclusion promotes financial stability in many ways. Khan (2011) argues that financial inclusion promotes financial stability through following ways- Firstly; financial inclusion provides financial services among the underprivileged people which reduce income inequalities between rich and poor, so they become socially and politically stable. Secondly, financial inclusion develop the health of household sector, small-medium firms by providing financial services which contribute to increased financial stability. Thirdly, financial inclusion provides saving facilities among the people by opening bank account which helps the people to move from cash economy, which helps to monitor Anti-Money Laundering (AML). Lastly, low-income people need to maintain stable financial behaviour where financial inclusion gives stable retail source of deposits for financial institution which increase the health of financial institution.

The main objective of this study is to investigate the impact of financial inclusion on bank stability in Bangladesh. This study makes several contributions to the literature, methodology, policy implication and contextually. First, there is a paucity of information in the literature whether or how financial inclusion influences on financial stability. Thus, this study contributes to the literature by identifying that financial inclusion promotes financial stability in the context of Bangladesh. It also contributes finance

growth literature in the sense that higher level of financial inclusion is likely to influence overall supply of credit to small firms (Beck, Demirgüç-Kunt, & Martinez Peria, 2008), and to firms in those industries that are in need external finance (Rajan & Zingales, 1998), enhancing overall economic growth. Because, financial institutions specially banks are able to providing financial services to households or firms in any economy. Second, it contributes to the policy implications with respect to financial liberalization and consolidation of the Bangladeshi banking sector. My results evident that better financial inclusion is supportive for financial liberalization which helps to achieve the fiscal objective of promoting financial stability in Bangladesh. Because financial inclusion is the result of financial liberalization process. This is due to the fact that, financial liberalization increases competition in the banking industry which banks the banking sector to increase efficiency, productivity, financial innovation and adoption of advanced technology to cope with the increased competition. Lastly, it contributes the financial stability literature identifying that greater financial inclusion depends on both characteristics such as profitability, efficiency, level of intermediation, bank size and macro-economic stability captured by inflation and GDP growth.

Literature review

Bank is financial institutions which engage intermediation in different activities and capital structures to fulfil their objectives with help of financial inclusion and to keep all classes' people (Allen, Demirguc-Kunt, Klapper, & Peria, 2016) and also build good relationship with their valuable customers (Petersen & Rajan, 1995). In Bangladesh financial inclusion has become most important issue specially in Banking sector to stable their function, where its able to focussed on many services likes SME banking, Mobile banking, ATM both, Bank branches, student Account, Home loan facility, SME loan facility and different deposits schemes (Jahan, De, Jamaludin, Sodsriwiboon, & Sullivan, 2019; Klein & Mayer, 2011). To develop good relationship with all levels of customers banking sector need various kinds of products and services (Shahabuddin, Noman, & Pervin, 2013; Petersen & Rajan, 1995). And banks can also expand their branches to provide financial services which will able them to reach all classes of people throughout country and reduced poverty.

"The stark reality is that most poor people in the world still lack access to sustainable financial services, whether it is savings, credit or insurance. The great challenge before us is to address the constraints that exclude people from full participation in the financial sectors. Together, we can and must

build inclusive financial sectors that help people improve their lives."—Former United Nations Secretary General Kofi Annan.

Financial inclusion is a process, which provides financial services like credit facility, saving account, payments, pensions and insurance product to the underprivileged people at an affordable price, which delivered in a sustainable way. Financial inclusion reduces liquid constrains and encourages for investment which has important effects on an economy. It bridges gap between the rich and the poor. It is a way of economic growth achieved by making availability of finance to the underprivileged people. In financial sector, financial institutions focus on cheap retail deposits to reduce their marginal cost and become more stable (Ahmad & Hassan 2007). Roengpitya, Tarashev, and Tsatsaronis (2014) also argues that banks rely on retail deposits rather than wholesale and capital market to become more stable. It is also argued that compared to other sources of fund retail deposits are cheapest source of long term fund (Calomiris & Kahn, 1991; Song & Thakor, 2007). Calomiris and Kahn (1991) argues that underprivileged people are intensive user of saving instruments. Saving instruments gives greater flexibility for saving and payment to the households (Allen, Carletti, Cull, Qian, Senbet, & Valenzuela, 2014). Therefore, when banks focus on financial inclusion and get large number of customers, they can extend number of retail deposits which helps them to reduce overall costs and risk and thus help them to become more stable. Therefore, facilitaty accessibility of number of customers to a bank account, banks can reduce their costs and can cover their losses which enhance bank stability. Petersen and Rajan (1997) argues that when financial inclusion raises then supply of bank credit rises which is favourable external sources of individual. Angelucci, Karlan, and Zinman (2013) also argues that there is a positive impact on the people when they getaccess to credit. So, greater financial inclusion can promote the efficiency of bank intermediation which enhances soundness of banks (Hannig & Jansen, 2010).

Apart from ensuring banking stability, financial inclusion plays important role in Bangladesh especially in achieving the Sustainable Development Goals (SDGs) ensuring socio economic development in a country. When people save money in bank then financial development can seen able. In financial inclusion, individuals can save money and become capable to access financial services with bank account (Allen, Carletti, Cull, Qian, Senbet, & Valenzuela, 2014); and able to create good environment for quality education (Flug, Spilimbergo, & Wachtenheim, 1998); helps to make proper decisions (Mani, Mullainathan, Shafir, & Zhao, 2013) and develop stability (Ahmad &

Hassan, 2019; Beck, Demirgüç-Kunt, & Levine, 2007).

Previous scholars have suggested both negative and positive effect that financial inclusion could have on financial stability. Khan (2011) argues that financial inclusion promotes financial stability through following ways- a) when the number of small saver rises then the relative size and stability of deposits base rises which also reduce dependency on non-core financing of banks during their crisis; b) when financial institutions are able to lend their assets to small firms then their overall risk also reduces which promotes financial stability; c) when central banks are able to take flexible monetary policy then financial stability rises which is the result from financial inclusion. Adasme, Majnoni, and Uribe (2006) argues that large firms' systematic risk is lower than that of small firms. So small and medium firms are able reduce banks' lending risk which promotes financial stability. Morgan and Pontines (2014) argues that financial stability is increased with increasing number of credit facilities to small-medium firms by decreasing on performing loans and the possibility of default loan, which indicate positive relationship between financial inclusion and financial stability. Han and Melecky (2013) added that 10% increase in the share of people that have access to bank deposits could reduce the deposit growth drops (or deposit withdrawal rates) by 3 to 8% points. Khan (2011) argues that higher financial inclusion is negatively related with financial stability through following ways- a) When financial institution increases the number of borrowers then lending standard reduces; b) To reach small borrowers when financial institutions become engaged in outsource various functions then their reputational risk rises. c) Unregulated micro financing institution reduces financial systematic risk rises if micro-finance institutions are not properly regulated.

Bank contribution on financial inclusion in Bangladesh
Financial inclusion is a very important issue all over the world where Bangladesh also trying to include all the people under the finance. Financial inclusion can be defined as the use of financial services by the underprivileged people which helps them to access formal financial services through formal bank account and also reduces poverty and contributes to economic growth (Beck, Demirgüç-Kunt, & Levine, 2007; Bruhn & Love, 2014). Ahmad and Hassan, (2007) argues that bank branch and ATM will cover all the groups of income level customer which promote bank stability. Bangladesh Bank as a central bank tries to promote different financial modes such as digital finance, digital financial inclusion, fintech etc. From digital finance individuals will get financial services through mobile phones and

personal computers (Ozili, 2017). He also argues that digital finance is able to deliver financial services among the poor which reduces cost of intermediation of bank. According to the Brookings Financial and Digital Inclusion Project (FDIP) report, 2015 out of 21 countries Bangladesh has ranked 16th on its financial and digital inclusion efforts.

In Bangladesh, financial system is classified on three sectors: Formal sector, Semi-formal sector and Informal sector, where formal sector includes all the banks and non-bank financial institutions and semi formal represents all specialized financial institutions. Therefore, access to the formal financial institution is challenging for the rural people. For this purpose, banking sector of Bangladesh has introduced mobile banking facilities like Bkash, Rocket etc, which are able to connect all the people in Bangladesh. Bangladesh Bank has also introduced SME (Small- Medium Enterprise) banking facilities which is a tool of financial inclusion where it able increase economic growth, create new business sectors, reduces poverty and regional discrimination by providing loan. In Bangladesh, banks also allow children to open a saving account with a minimum deposit of Tk. 10 and children above 18 with accounts can take loan from the same bank. In addition, Bangladesh Bank also motivated to the financial institution to provide credit and loans to farmers, small and medium sized enterprises and female entrepreneurs. However, it is not known how financial inclusion promotes stability of the banking system in Bangladesh. To fulfil the literature gap and help policy makes to aware about the implications of financial inclusion, this study investigates the relationship between financial inclusion and bank stability in Bangladesh.

Table 1
Financial inclusion data in Bangladesh

Population, Total	*163,046,161
GDP per capita ($)	3124.4
Mobile cellular subscription	120350497
ATMs per 100000 adults	6.3
Commercial bank branch per 100000 adults	8.2
Account at a financial institution (% Age15+)	29.1
Mobile Account (% Age 15+)	2.7
Borrowed from financial institution (% Age 15+)	9.9
Saved at a financial institution(% Age 15+)	7.4

Sources: World Bank (World Development Indication 2014, Findex 2014), IMF Financial Access Survey 2013/2014, *Worldometer (2019) for total population

Methodology

In order to evaluating the effect of financial inclusion on financial stability of banks in Bangladesh, we use several financial ratios. Previous studies such as, Athanasoglou, Brissimis, and Delis (2008); Francis (2013); Heffernan and Fu (2008); Perera, Skully, and Chaudhry (2013) evident that the use of ratio is measure the literature of accounting and finance practices. And I use the following basic linear regression model:

$$Y_{it} = C + \sum \beta_{it} X_{it} + \sum \beta_{it} W_{it} + \sum \gamma_{it} Z_{it} + e_i \quad \text{.............................(1)}$$

In this model, i indicates individual bank, t indicates time period, Y_{it} indicates bank stability, X_{it} indicates financial inclusion which are dependent variables. W_{it} indicates bank specific variables and Zitindicates macroeconomic variables which are independent variables. And c indicates constant, β_{it} indicates coefficient of the regressors &ei indicates standard error which indicate the effect of all other variables on dependent variables I use in the function except independent variables. Itconsiders NPL ratio and *lnZ*-scoreas indicators of bank stability following the works of Noman et al., (2017, 2018, 2020, 2022)[1] and log of Automatic teller machine (*ln*ATM) per 100 thousand of people, and log of bank branch (lnBB) as indicators of financial inclusion following the work of Neaime and Gaysset (2018). It considers some bank specific variables which are net interest margin (NIM) as indicators of profitability, equity to total asset (ETA) as indicators of capitalization ratio or leverage ratio, loan loss and nonperforming loan to gross loan (LLRGL) as indicators of credit risk, natural logarithm of total asset (LTA) as indicators of bank size, net loan to total asset (NLTA) as indicators of bank liquidity, natural logarithm of bank asset (LBA) and Macro economic variables are financial system deposit to gross domestic product (FSDGDP) and private credit to gross domestic product (PCGDP) real gross domestic product (GDP) growth rate and inflation rate.

Bank size: Natural logarithm of total assets is an indicator of bank size (Albaity, Mallek, & Noman, 2019). Liu, Molyneux, and Nguyen (2012) claims that large banks are able to take more risk because they have higher market power. So, bank size is positively related with bank stability.

Profitability: Net Interest Margin (NIM) indicates profitability of a bank (Albaity, Noman, & Mallek, 2021). A potent profitability profile and net income of a bank shows its capability to support present and future sound

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[1] Please find the extensive review of literature on financial stability in Noman et al., (2017, 2018, 2020, 2022). We have not repeated the review here to conserve the space.

operation and absorb financial shocks. When a bank builds suitable capital base and pays suitable dividends to its shareholder this ascertains the ability to absorb financial losses. So, the effect of profitability on bank stability is positive (Albaity, Mallek, & Noman, 2019).

Credit risk: Loan loss and nonperforming loan to gross loan (LLRGL) is indicators of credit risk which is negatively related with bank stability. Financial institutions try to increase their stability by considering credit risk management techniques where central bank also determines policy such as level of loan loss based on their loan Noman, Pervin, Chowdhury, and Banna (2015).

Capitalization ratio or leverage ratio: Equity to total asset (ETA) is an indicator of capitalization ratio or leverage ratio, which measure bank's capability to exploit loss and how equity impact on banks stability (Noman, Isa, Mia, & Sok-Gee, 2018). The effect of equity to total asset (ETA) on banks stability may be positive or negative because its higher ratio indicates bank operate their business with profit and lower ratio indicates bank operate their business with capital crisis (Noman, Isa, Mia, & Sok-Gee, 2017).

Bank liquidity: Net loan to total asset (NLTA) is an indicator of bank liquidity as a proxy (Noman, Isa, Mia, & Sok-Gee, 2017). Loan constitutes large amount of interest earning which is positively related with bank stability, if banks are able to use their deposits in loan creation then the ratio raises interest income and positively related with bank stability. But high ratio creates credit risk of the bank as well as liquidity level also reduces which negatively correlated with bank stability.

Inflation: Inflation means a general and progressive increase in prices which cut the acquisition of something for payment control and it also affects on bank stability. For reducing inflation central bank takes monetary policy (Noman, Pervin, Chowdhury, & Banna, 2015; Albaity, Noman, & Mallek, 2021).

GDP: Gross domestic product (GDP) describes the monetary value of goods and services produced by a country during one year that means Gross domestic product equals to consumption plus Govt. expenditure plus Investment plus Exports minus Imports. GDP-Gross domestic product also effects on bank stability (Noman, Pervin, Chowdhury, Hossain, & Banna, 2015; Albaity, Noman, Mallek, & Al-Shboul, 2021).

This study aims to identify the effect of financial inclusion on financial stability of banks in Bangladesh. Financial inclusion is captured with number of ATM per 100 thousand of people, and financial stability is proxied by Z-scope and NPL ratio, and data have been collected from all commercial banks of Bangladesh for 2002-2014 period. In examining the effect of

financial inclusion on financial stability, we have controlled a number of bank specific and macro-economic control variable. Where, bank specific control variables are profitability, bank size, capitalization, liquidity and macro-economic control variables are inflation rate, gross domestic product growth rate, PCGDP, and FSDGDP. Based on *Bush-pagan legrangian test and Hausman* test, the researchers of the study choose to use the Random effect model to estimate the financial inclusion-stability nexus. In order to ensure accuracy of Random effect model, Ordinary Least Square (OLS) model and Generalized Least Square (GLS) model have also been used. All the models are robustly shown that more financial inclusion is good for financial stability of banks in Bangladesh.

Data

In order to investigate the effect of financial inclusion on financial stability (especially banks) of Bangladesh, the researchers of the study used both bank characteristics data and macroeconomics data where, bank characteristics data were collected from Bankscope database and macroeconomics data were collected from World Bank database from period of 2002 to 2014. The study has used data from all types of commercial banks including public, private and foreign banks to construct a panel of 4863 bank year observations from 47 commercial banks. For processing the results, the economic software package STATA 13 version has been used.

Table 2
Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
*ln*Z-SCORE	340	3.513786	1.247195	.4333008	7.395952
NPL ratio	263	8.95703	11.1741	.353	57.262
*ln*ATM	375	0.7398157	1.281247	-2.078002	2.049926
*ln*BB	375	2.034838	.075565	1.925917	2.133049
*ln*BA	308	5.90165	.3446238	5.511965	6.382699
PCGDP	348	34.19939	4.694948	27.43633	39.76236
FSDGDP	348	43.79576	2.390241	40.28014	47.73829
Loan quality	303	4.546139	4.426012	.749	22.045
Bank size	375	6.793576	1.130222	3.30968	9.354423
Profitability	374	3.399602	1.947401	-6.398	14.173
Capitalization	375	8.0564	12.50523	-42.912	66.924
Liquidity	374	64.31633	14.40352	1.768	99.096
GDP growth	375	5.911224	.7809346	3.833	7.05
Inflation rate	375	7.395389	1.764732	3.33	10.704

Natural logarithm of Z-score and NPLGL stands for nonperforming loan to gross loan capture bank stability. Financial inclusion is captured with *ln*ATM, lnBB, where, *ln*ATM stands for log automated teller machine, lnBB stands for log bank branch, Loan quality is measured with loan loss reserve to gross loan ratio, bank size is captured withnatural log total assets, Profitability is measured with net interest margin ratio, capitalization is measured with equity to total asset, GDP stands for gross domestic products, INF stands for Inflation rate, PCGDP stands for private credit to gross domestic product, FSDGDP stands for financial system deposit to gross domestic product.

4. Analysis and finding

4.1 Descriptive statistics

Table 2 summarizes and describes variables of interest where mean is the average or the central tendency, maximum and minimum are the maximum and minimum value while standard deviation measures how the observations are spread.

In table 2, the lnZ-score of observation is 340 and mean is 3.513786 and minimum number is .4333008 and maximum number is 7.395952. The non-performing loan ratio (NPLGL) among the commercial bank of Bangladesh is varied from 0.353 to 57.262 with the mean and standard deviation 8.95703 and 11.17541 respectively which indicates the there is a high volatility among the bank's ability in credit management.

The total Asset among the banks in Bangladesh is different from 3.30968 to 9.354423 with the mean is 6.793576 and standard deviation is 1.130222 which indicates banks are financially stable. Table 2 shows that equity to total asset's mean is 8.0564 and Std. Dev. is 12.947401 which measure bank's ability to absorb loss.

log Automated teller machine (LATM)'s mean is 3.567361 which indicates that there are 3.567361 Automated teller machine ATM for one lakh people and Bank Branch's mean is 7.672699 which also indicate there are 7.672699 branches are available for one lakh people.
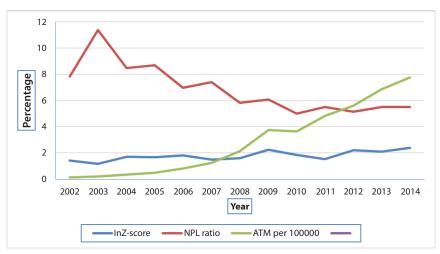
Figure 1

Year wise movement of financial stability and financial inclusion in 2002-2014 periods
Source: Bankscope database

The above figure 1 shows year-wise movement of financial stability and financial inclusion of Bangladeshi banking sector in the period of 2002 to 2014. Here, financial stability is captured with *lnZ*-score and NPL ratio, and financial inclusion is captured with the number of ATM for per 100000 populations. The figure shows that *InZ*-score and NPL ratio move counter-cyclically over the whole period. The movement of *lnZ*-score is upward in whole period despite some fluctuation, while the movement of NPL ratio is down ward in the whole study period. A sharp upward trend is observed for the number of ATM for per lakh population. Thus, the above figure suggests that financial stability promotes financial inclusion for banking sector of Bangladesh.

Table 3

Correlation metric

V	lnZ-Score	NPLGL	lnATM	lnBB	lnBA	PCGDP	FSDGDP	LLRGL	lnTA	NIM	ETA	NLTA	GDP	INF
lnZ-Score	1.000													
NPLGL	-.3259	1.000												
	***													
*ln*ATM	.1732	-.2858	1.000											
		***												
*ln*BB	.1433	-0.2552	0.941	1.000										
	***	***	***											
lnBA	-.0823	-.1395	.6182	.6401	1.000									
PCGDP	-.0325	-0.1619	0.672	-0.636	.9502	1.000								
	***	***	***	***										

V	lnZ-Score	NPLGL	lnATM	lnBB	lnBA	PCGDP	FSDGDP	LLRGL	lnTA	NIM	ETA	NLTA	GDP	INF
FSDGDP	0.0929***	-0.0651***	0.309***	-0.376***	.5695	0.443***	1.000							
Loan quality	-0.2478***	-0.8154***	-0.189***	-0.175***	-0.043	-0.076***	-0.012***	1.000						
Bank size	-0.1918	0.0348***	0.335	0.323	0.259	0.302	0.151***	0.065***	1.000					
Profitability	0.1549***	-0.4015	0.404	0.413	0.261	0.2852***	0.184***	-0.202	-0.06***	1.00				
Capitalization	0.3555***	-0.6223***	0.239***	0.289***	0.098	0.0432***	0.117***	-0.291***	-0.2809***	0.3624***	1.000			
Liquidity ratio	-0.0382***	-0.1666***	-0.0784	-0.1381***	-0.0087	0.0528***	-0.0654***	-0.0608***	-0.1309	0.0372	-0.4652	1.000		
GDP growth rate	0.1010	-0.1307***	0.4938***	0.3207***	0.1041	0.3257	0.1740	-0.0918	0.1494	0.1815***	0.0344***	0.0463***	1.000	
Inflation rate	-0.0278	-0.1318***	0.4120***	0.2542***	0.1464	0.3692	0.0603	-0.0857	0.1593	0.1687***	0.0219***	0.0531***	0.617***	1.000

Among the variable natural logarithm of Z-score and NPLGL stands for nonperforming loan to gross loan capture bank stability. Financial inclusion is captured with lnATM, lnBB, where, lnATM stands for log automated teller machine, lnBB stands for log bank branch, Loan quality is measured with loan loss reserve to gross loan ratio, bank size is captured with natural log total assets, Profitability is measured with net interest margin ratio, capitalization is measured with equity to total asset, GDP stands for gross domestic products, INF stands for Inflation rate, PCGDP stands for private credit to gross domestic product, FSDGDP stands for financial system deposit to gross domestic product.

***, **, and * indicate the coefficient is significant at 1%, 5% and 10% respectively.

The table 3 demonstrates the correlation matrix of the variables used in the analysis. This study determines the bi-variate relationship between dependent variable and independent variable by using correlation matrix. In addition, it is also used to identify the multicolinearity problem among the independent variable.

In table 3, we see that, the relationship between dependent variable z-score and non performing gross loan is negative and significant. This means that lnZ-score and NPL ratio is negatively correlated suggesting that highly financially solvent bank has less credit risk. In other words, the bank facing high credit risk is less financially solvent and it's distance from default is low. On the other hand, it is found that the sign of the independent variables bank size, PCGDP, loan quality, liquidity and inflation with dependent variable lnZ-score is negative indicating that the mentioned variables are negatively related with lnZ-score. While the sign of the independent variables lnATM, lnBB, FSDGDP, profitability, capitalization and GDP growth with dependent variables lnZ-cores is positive indicating that the mentioned variables are positively related with lnZ-scores. And similarly it is found that, the sign of independent variables lnATM, lnBB, PCGDP, FSDGDP, loan

quality, profitability, capitalization, liquidity, GDP growth and inflation with the variable of Nonperforming loan to gross loan (NPLGL) are negatively related with NPLGL. And bank size is positively related with NPLGL. Then it is found that there is correlation between in all variables which value is less than 60% except *lnBB, lnBA,* PCGDP, capitalization and inflation. Therefore, we say that the multi-correlation problem in all variables are not highly correlated that is why our regression output will not to be biased.

Regression results and analysis:

Firstly, the researchers of the study ran Breush and Pagan Lagrangian multiplier test to identify whether to choose between panel and pool regression models on the basis of the significant value of the lagrangian multiplier test. Then the researchers used Hausman test to select random effect or fixed effect model.

Based on the significant value of the test statistics of the Breush and pagan lagrangian multiplier test, the researchers have chosen panel data model. Later, the researchers have selected random effect method to investigate the role of financial inclusion on bank stability in Bangladesh.

Table 4 and 5 report OLS, Random effect and GLS results of the role of financial inclusion on bank stability in models 1, 2 and 3 respectively. Table 4 considers lnZ-score and Table 5 considers NPL ratio as bank stability measure.

Table 4

Effect of financial inclusion on financial stability considering Z-score as dependent variable

Model	OLS	Random effect	GLS regression
	1	2	3
Dependent Variable	*ln*Z-score	*ln*Z-score	*ln*Z-score
*ln*ATM	.227**(.102)	.227**(.111)	.227**(.099)
*ln*BB	-1.123(.928)	-1.091(.885)	-1.123(.905)
PCGDP	.019(.068)	.013(.065)	.019(.066)
FSDGDP	.077*(.043)	.077*(.042)	.077*(.042)
Loan quality	-.061***(.019)	-.048***(.023)	-.061***(.019)
Bank size	-.196*(.107)	-.235*(.135)	-.196(.104)
Profitability	.007(.052)	.045(.059)	.007(.050)
Capitalization	.032**(.012)	.032***(.015)	.032***(.012)
Liquidity	.013*(.007)	.012*(.008)	.032*(.012)
GDP growth	.079(.133)	.082(.126)	.079(.130)
Inflation rate	-.094*(.054)	-.091*(.051)	-.094*(.052)
CONS	6.56**(2.627)	6.657**(2.613)	6.561**(2.561)

The dependent variables natural logarithm of Z-score and NPLGL stands for nonperforming loan to gross loan capture bank stability. Financial inclusion is captured with lnATM, lnBB, where, lnATM stands for log automated teller machine, lnBB stands for log bank branch, Loan quality is measured with loan loss reserve to gross loan ratio, bank size is captured with natural log total assets, Profitability is measured with net interest margin ratio, capitalization is measured with equity to total asset, GDP stands for gross domestic products, INF stands for Inflation rate, PCGDP stands for private credit to gross domestic product, FSDGDP stands for financial system deposit to gross domestic product. The values in the table indicate the coefficient of the variables, the values in the parenthesis show robust standard error.
***, **, * indicate significant of coefficient value at 1%. 5%, and 10% respectively.
Source: Bankscope database

Table 4 shows the effect of financial inclusion (*ln*ATM) on bank stability (*ln*Z-score) controlling a number of banks specific and macroeconomic control variables. It is found that, the coefficient of *ln*ATM on *ln*Z-score is positive and significant in all models, suggesting that there is a positive relationship between financial inclusion and financial stability. It demonstrates that one unit rise in financial inclusion (Number of ATM) increases financial stability by 0.227 unit in all models.

Among the control variables, it is found that the relationship between equity to total asset (ETA) is positively related with z-score which indicates higher capitalization promotes bank stability. It further shows that higher liquidity, loan quality, financial system deposit, economic growth supportive for financial stability, on the other hand, inflation and bank size weaken stability in the country.

Table 5

Effect of microeconomic & bank specific variables on financial stability considering NPL ratio as dependent variable-

Model	Random effect	OLS	GLS regression
	1	2	3
Dependent Variable	NPLGL	NPLGL	NPLGL
lnATM	-1.458***(.508)	-.919*(.477)	-.919**(.464)
lnBB2.128(3.567)	.237(4.443)	.237(4.321)	
PCGDP	-.055(.256)	-.029(.324)	-.029(.315)
FSDGDP	.055(.178)	.017(.209)	.017(.203)
Loan quality	1.101***(.112)	1.447***(.098)	1.447***(.095)
Bank size	2.277***(.672)	.551(.44)	.551(.428)
Profitability	-.683**(.275)	-.724***(.248)	-.724***(.241)
Capitalization	-.571***(.066)	-.521***(.049)	-.521***(.048)
Liquidity	.012(.051)	-.036(.046)	-.036(.045)
GDP growth	-.824*(.497)	-.980(.626)	-.980(.608)
Inflation rate	.051(.204)	-.008(.258)	-.008(.251)
CONS	-8.244(11.24)	12.18(12.92)	12.182(12.56)

The dependent variables natural logarithm of Z-score and NPLGL stands for nonperforming loan to gross loan capture bank stability. Financial inclusion is captured with lnATM, lnBB, where, lnATM stands for log automated teller machine, lnBB stands for log bank branch, Loan quality is measured with loan loss reserve to gross loan ratio, bank size is captured with natural log total assets, Profitability is measured with net interest margin ratio, capitalization is measured with equity to total asset, GDP stands for gross domestic products, INF stands for Inflation rate, PCGDP stands for private credit to gross domestic product, FSDGDP stands for financial system deposit to gross domestic product.
The values in the table indicate the coefficient of the variables, the values in the parenthesis show robust standard error.
***, **, * indicate significant of coefficient value at 1%. 5%, and 10% respectively.
Source: Bankscope database

Table 5 shows the coefficient of lnATM for NLP ratio is negative and significant in all models, indicating that more number of ATM reduces bank credit risk taking. This result suggests that increased financial inclusion promotes bank stability in Bangladesh reducing credit risk-taking tendency on banks, which is consistent with our previous findings. Thus, this literature implies that the central bank's initiatives to promote financial inclusion expect increased stability in the banking system of Bangladesh.

5. Conclusion
This study aims to investigate the effect of financial inclusion on financial stability of banks in Bangladesh. Financial inclusion is captured with number of ATM per 100 thousand of people, and financial stability is proxied by Z-scope and NPL ratio, and data have been collected from all commercial banks of Bangladesh for 2002-2014 period. In examining the effect of financial inclusion on bank stability, the researchers have controlled a number of bank specific and macro-economic control variable. Where, bank specific control variables are profitability, capitalization, loan quality, liquidity ratio, and macro-economic control variables are inflation, gross domestic product growth rate. Based on *Bush-pagan legrangian test and Hausman* test the researchers have chosen to use the Random effect model to estimate the financial inclusion-stability nexus. In order to ensure accuracy of Random effect model, Ordinary Least Square (OLS) model and Generalized Least Square (GLS) model have also been used. All the models are robustly shown that more financial inclusion is good for financial stability of banks in Bangladesh.

The results show that all variables such as the coefficient of lnATM is positive for lnZ-score and negative for NPL ratio, suggesting that financial inclusion increases bank stability in Bangladesh weakening bank credit risk taking tendency. Based on the positive relationship between financial

inclusion and financial stability, this study proposes to adopt technological innovation, research and development to promote financial inclusion in order to get benefit of financial stability in Bangladesh. As, technological development increases competitive pressures among the banks, the regulators should focus on strengthening institutional framework to neutralize the negative effect on competition on the stability of the banking system.

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Corresponding author
Mohim Uddin Chowdhury can be contacted at: mohimuchowdhury@gmail.com