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IS DIGITAL FINANCIAL INCLUSION GOOD FOR BANK STABILITY AND SUSTAINABLE ECONOMIC DEVELOPMENT? EVIDENCE FROM EMERGING ASIA

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Abstract

In this current era of the fourth industrial revolution, both the negative and positive effects of financial inclusion raise the question of whether digital finance can be a solution for financial stability through attaining sustainable economic growth or not. Hence, considering the aftermath of the 2007–2009 GFC, which had a catastrophic effect on the overall banking industry, this study aims to examine the effect of digital financial inclusion (DFI) on banking stability through promoting sustainable economic development using an unbalanced panel data of 574 banks from seven emerging Asian countries from 2011 to 2018. The results suggest that DFI brings banking stability and an integrated digital financial system among the emerging Asian banks is not merely a way of ensuring banking stability, rather it ensures inclusive and sustainable economic development that helps achieve financial sustainability, which will ultimately lead to achieving the SDGs by 2030.

Keywords: banking stability, digitization, digital finance, sustainable economic development, emerging Asia

JEL Classification: G21, G28

Contents

1. INTRODUCTION

Digital financial inclusion (DFI) is not very different from the notion of financial inclusion (FI): It is the extension phase of FI where the notion of advanced technology is entertained. It has been widely discussed as a global issue in recent years (Ozili 2018) as it is seen as a change agent that can bring about a revolutionary development in the overall global financial sector. In this regard, Jamie Caruana, the General Manager of the Bank for International Settlements, told world financial analysts, "(they) have the opportunity—and indeed the responsibility—to prepare the standard-setting world for both the risks and the rewards of the digitization of financial services" (CGAP 2015). Basically, DFI denotes financial services that are carried out remotely in a cashless manner using different electronic devices from which both parties (e.g., providers and receivers) gain benefits (Klapper 2017).

Considering the undeniable importance and the prospects of DFI, banks of emerging Asian countries are on their way to implementing digital financial services (DFS) (e.g., FinTech, E-wallet, and other cashless transactions) in a full-fledged manner, although many banks from different countries have already launched DFS in a minimal way and others are paving the way to doing so. This is because wider inclusion of easily accessible financial services helps banks attain stability (Ahamed and Mallick 2019), financial advancement (Demirgüç-Kunt et al. 2015), and a flourishing global financial sector (Iqbal and Llewellyn 2002). Like the global banking sector, banks in emerging Asian countries are also considering including DFS as they ensure banking stability, which sends out a message about the economic stability of any country and will consequently lead towards achieving the sustainable development goals (SDGs) by 2030 (Banna et al. 2020a). To attain the SDGs, economic sustainability is a must that can be ensured through the banking sector along with other financial sectors. Attainment of the SDGs becomes impossible without filling a huge investment gap. There is a $2.5 trillion investment gap to achieve the SDGs by 2030 (Wilson 2016, July), which can be reduced by the banking sector along with other financial institutions (Niculescu 2017).

To meet this huge investment gap for attaining the SDGs, scholars, and in particular financial analysts, foresee the prospects of DFI through a wider lens as it is the recent phase of FI, which played a great role during the 2007–2009 global financial crisis (GFC). The crisis caused a USD15 trillion loss in the global financial sector (Ahmed et al. 2015). At that time FI played a major role in retaining banking stability (Ahamed and Mallick 2019). Although FI has brought a myriad of positive changes and benefits for underprivileged and less developed people, sometimes its proper implementation and utilization has become a burden for those who are unable to afford it. Therefore, as well as its positive impacts, it also has negative impacts on the financial system, which could be distressingly affected by excessive financial innovations (Mani 2016). However, both the negative and positive effects of FI raise the question of whether the implementation of digital finance, the latest innovation of FI, in the emerging Asian banking sector can be a solution for attaining banking stability through ensuring sustainable economic development or not. Hence, this paper aims to investigate, in the context of the emerging Asian banking industry, how DFI promotes banking stability through ensuring sustainable economic development.

Despite general awareness of the unavoidable importance of the implementation of DFI, studies are very rarely found on this issue, except for a few like Ahamed and Mallick (2019), who demonstrate the impact of FI (but not DFI) in general on bank stability, and Ozili (2018) and Koh, Phoon, and Ha (2018), who outline the prospects and challenges of DFI, while Arner, Buckley, and Zetzsche (2018) sketch a framework for digital financial transformation. However, to the best of our knowledge, no such studies have yet attempted to investigate empirically the impact of DFI on emerging Asian banking stability through ensuring sustainable economic development. Thus, this empirical study fills the gap by examining the role of DFI, in the context of the emerging Asian banking sector, in spurring banking stability through ensuring sustainable economic development. The study has used the data of 574 banks from seven emerging Asian countries (the People's Republic of China (PRC), India, Indonesia, Malaysia, Pakistan, Thailand, and the Philippines) over the period 2011 to 2018 from the Orbis Bank Focus, Global Findex, and Financial Access Survey (FAS) databases by deploying panel-corrected standard errors and two-stage least-squares – instrumental variable techniques. The results suggest that digital financial inclusion brings banking stability and an integrated inclusion of digital finance by the emerging Asian banks is not merely a way of ensuring banking stability, rather it ensures sustainable economic development that will ultimately lead to achieving the SDGs.

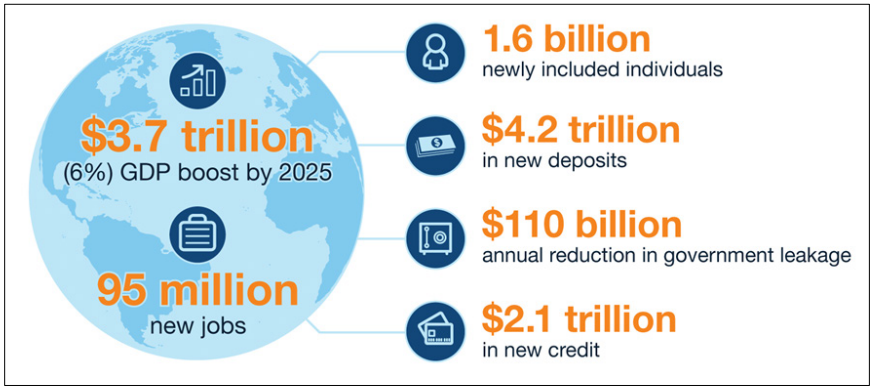
The rest of the paper is organized as follows. Section 2 presents a review of the literature while the methodology of the study is elucidated in Section 3. Sections 4 and 5, respectively, illustrate the analysis and draws conclusions with policy recommendations.

2. LITERATURE REVIEW

2.1 The Prospects of DFI at a Glance

The impacts and prospects of DFI are no longer abstract notions; rather, time demands their proper execution. The Executive Director of the Alliance for Financial Inclusion (AFI) Hannig (2017) says: "The adoption of digital finance will have a significant impact not only on financial inclusion, but also inclusive economic growth." Highlighting the importance of DFI in their report, Manyika et al. (2016) present some important notes based on the findings of field visits to seven countries—Brazil, the PRC, Ethiopia, India, Mexico, Nigeria, and Pakistan—and more than 150 expert interviews. They report (as shown in Figure 1): "Digital finance has the potential to provide access to financial services for 1.6 billion people in emerging economies, more than half of them women. Widespread adoption and use of digital finance could increase the GDP of all emerging economies by 6%, or USD3.7 trillion, by 2025," which is equivalent to the size of the economy of Germany. Moreover, 95 million new jobs would be created in all sectors across the world through this additional GDP. Since GDP is seen as a key developmental index of an economy, the implementation of DFI in the Islamic banking sector will contribute to enhancing the GDP, which will help to alleviate poverty and ultimately lead to inclusive economic growth to achieve the SDGs.

Figure 1: The Impacts and Prospects of DFI



Source: McKinsey Global Institute (2016).

2.2 Relevant Studies

Since DFI is the most updated phase of FI and they both are interconnected with each other, this section gives an account of both the terms and their relation to bank stability and sustainable economic growth. In recent years, DFI has been a much discussed issue in the world and is seen as a revolutionary innovation in the field of finance and banking. In their study, Siddik and Kabiraj (2020) show the impact of digital finance on FI and proper implementation of DFI can spur sustainable economic growth by eradicating poverty. Poverty is more visible among rural and underprivileged people, who are usually neglected in most of the developed society, which hinders the ultimate financial growth of any country. These types of deprived people can be included in formal financial services by implementing DFI properly. Ozili (2018) illustrates that the key aim of DFI is to provide formal financial services to the poor, rural, and underprivileged or unbanked people, which has a long-run impact on banking performance. Inclusion of people in formal financial services helps banks to be financially stable and consequently benefits the government through generating higher tax revenue (Manyika et al. 2016). Such types of financial services are delivered via smart mobile phones, personal computers, or laptops, which need an internet connection (Manyika et al. 2016).

According to Gomber, Koch, and Siering (2017), DFS include innovative financial products, finance-related software, and a great way of interacting and communicating with customers provided by FinTech and other finance-related service providers (e.g., BigTech firms). They can transform people from cash-based to cashless transactions where they need a mobile phone, one of which is owned by almost 50% of people in the developing countries (World Bank Group 2013). Most of the countries of the world are turning to these services. According to Pénicaud and Katakam (2019), more than 80 countries around the world are launching DFS through mobile phones as they bring welfare to the people (CGAP 2015).

Proper application of DFI increases the profitability of banks, which brings financial growth and stability (Ozili 2018). García and José (2016) show that FI and financial stability move in parallel and financial stability is an indicator of banking stability. Reviewing the existing literature, they also show the nexus between financial inclusion and financial stability. Being the recent phase of FI, scholars reckon that DFI is more effective in terms of ensuring financial stability, which indicates banking stability.

As DFI is an ongoing research topic, empirical studies showing the impact of DFI are very scarce. The recent study by Klapper, Miller, and Hess (2019) shows that through DFS, informal business institutions can be registered as formal business institutions and help the government to collect taxes more easily by enforcing laws since in the database all the records are available and there is no way to escape payment. More tax collection contributes to the national revenue sector and eventually makes the country's economic growth stable. Before launching the DFI in full swing, prime focus should be given to financial literacy. Financial literacy is an inseparable part of DFI that enables individuals to enhance financial resilience. But in fact, globally only 33% of all adults have financial knowledge—that is, they understand at least three out of four main financial literacy issues, such as knowledge of inflation, interest rates, risk diversification, and compounding interest, which are essential for decision-making in financial affairs (Klapper and Lusardi 2020). Moreover, through the proper application of DFI, the gender gap in FI can be minimized. In most of the developing economies, women are still lagging behind in terms of having a formal bank account. In this regard, the study of Sioson and Kim (2019) shows that DFI plays a significant role in reducing the gender gap in financial services.

Moreover, inclusive finance brings banking stability and economic sustainability. Taking a sample of 31 Asian countries from the period 2004 to 2016, the empirical study of Li, Wu, and Xiao (2020) finds that FI has an enormous positive influence on financial sustainability. The empirical study of Neaime and Gaysset (2018) on MENA countries shows a very close association between FI and bank stability. Beck, Senbet, and Simbanegavi (2014) say that FI is viewed as one of the important drivers of the financial growth and stability of the banking sector. The empirical study of Ahamed and Mallick (2019) also finds a very significant impact of FI on bank stability. In some cases, FI seems to be incomplete without the implementation of DFI, which plays a key role in accelerating financial inclusion. The empirical study of Senou, Ouattara, and Acclassato Houensou (2019) in the context of West Africa shows that the affordability, accessibility, and availability of DFI should be taken into account to accelerate FI in that region. Moreover, DFI strengthens the functions of FI since, as already stated, the nexus between FI and DFI is very strong and DFI fills the gap of FI by implementing the latest technological innovation (Moufakkir and Mohammed 2020). Another study by Banna et al. (2020a) shows that FI after the GFC played a very significant role in promoting banking efficiency where it was eventually suggested that DFI should be implemented in the banking sector to keep pace with the competitive world that will help ensure banking stability and spur sustainable economic development.

So, realizing the impact of DFI found through previous studies, emerging Asian banks are on the way towards implementing DFI in full swing. Although a considerable number of empirical and theoretical studies pertinent to the role of FI, DFI, banking stability, and sustainable economic development exist, very few studies, in the context of emerging Asian banks, have attempted to empirically investigate the impact of DFI on banking stability that eventually leads to sustainable economic development. Since it is evident from the existing literature that the integration of digitalization in financial inclusion is a noble mechanism for reaching out to the people with more convenient financial support through the utilization of technologies, the current study endeavors to dig deep into the opportunities and impacts of DFI to achieve banking stability through sustainable economic development. But the existing literature has limitations in exploring the impacts of DFI on banking stability through sustainable economic development, although there are a few studies measuring the impact of financial inclusion on banking stability through sustainable economic development. Thus, it is hoped that the proposed study will add value to the prompt implementation of DFI in the emerging Asian banking sector that will ultimately facilitate the achievement of

sustainable operation of financial institutions and ensure banking stability through sustainable economic development.

3. METHODOLOGY

This study examines the impact of DFI and the effect of its interaction with GDP on emerging Asian banking stability to see how DFI helps to achieve banking stability through sustainable economic development. The following data and methods have been used to analyze the relationships.

3.1 Data

Though a good number of financial companies along with the banking sector render finance-related services, this study only considers the data of the banking sector, and more specifically, the emerging Asian banking sector. This is because, the Asian financial crisis was mainly the result of banking and currency problems that has attracted the interest of the concerned authorities to surmount the crisis by ensuring Asian banking stability. This region has also drawn the attention of scholars as it has experienced rapid growth in different sectors such as industrialization, trade, and commerce, etc., where the PRC and India are in leading positions. The study considers seven emerging Asian countries, namely Malaysia, Pakistan, Indonesia, the PRC, Thailand, India, and the Philippines. We consider these emerging Asian countries as the main agenda of these countries is to perform their financial activities in a cashless manner, which is also the prime aim of digital financial inclusion. More specifically, the governments of these countries are willing to implement the digital banking system in full swing. Thus, many of these countries' financial institutions have started to provide digital financial services, for example: PayTM, Yono by SBI, ICICI pockets, etc. (India); Alipay, Wechat pay, etc. (PRC); May Bank QR pay, CIMB pay, TnG E-wallet, etc. (Malaysia); QR pay, Boost pay, etc. (Indonesia); True Money wallet, Omise, etc. (Thailand); Banko, BDO, Bitbit, etc. (Philippines); and EasyPaisa, JazzCash, UBL Omni, etc. (Pakistan).

Initially, the study took the annual data of 600 commercial banks from all seven emerging Asian countries. After that, due to data unavailability and missing values, some banks were excluded from the sample. Finally, the unbalanced panel data of 574 banks over the period 2011–2018 were considered. The reason for considering this period is that this study wants to see the after effects of the GFC on banking stability and data on DFI or FI are available from 2011 and onwards. The proportions of the sample size in our analysis are given in Table 1, in which the PRC carries the highest percentage (40%) followed by Indonesia (20%) and the Philippines (12%). Data were taken from various sources: (i) the Orbis Bank Focus database for bank-specific data; (ii) the Financial Access Survey (FAS), International Monetary Fund (IMF), and Global Findex databases for DFI data; and (iii) the World Development Indicators (WDI), World Bank database, and previous literature for macroeconomic variables and instrument data.

Table 1: The List of Countries and Number of Banks

Country Name	Number of Banks	Observations	Sample %
PRC	229	1,832	40
India	55	440	10
Indonesia	114	912	20
Malaysia	48	384	8
Pakistan	33	264	6
Philippines	69	552	12
Thailand	26	208	5
Total	574	4,592	100

3.2 Methods

3.2.1 Bank Stability

Following Kim, Batten, and Ryu (2020), this study uses two financial stability measures: a) Z-score and b) Sharpe ratio. Z-score has gained wider acceptance in the banking and finance literature and has been considered an unbiased parameter of bank riskiness (Fang, Hasan, and Marton 2014) that is also called "distance to default." Z-score has been measured in the following way:

$$Z - score_{it} = \frac{ROAA_{it} + EQT_{it}}{\sigma(ROAA)_{it}} \quad (1)$$

where $ROAA_{it}$, EQT_{it}, and $\sigma(ROAA)_{it}$ are the return on average assets, the equity-to-assets ratio, and standard deviation of the ROAA of bank *i* in year *t*, respectively. The score can be interpreted in such a way that if the mean is higher than the number of standard deviations, the returns will have to fall down before all equity in the bank becomes depleted (Ahamed and Mallick 2019). The natural logarithm of the Z-score has been used in this study in order to minimize the skewness. Furthermore, following Yin (2019), this study also considers the Sharpe ratio as another proxy for bank stability in the following way:

$$Sharpe\ ratio_{it} = \frac{ROAE_{it}}{\sigma(ROAE)_{it}} \quad (2)$$

where $ROAE_{it}$ and $\sigma(ROAE)_{it}$ are the return on average equity and the standard deviation of the ROAE of bank *i* in year *t*, respectively. The higher the ratio, the higher the banking stability, similarly to the Z-score. Apart from these, the nonperforming loans ratio (NPL) is also considered an alternative proxy for bank stability in which a lower ratio represents higher stability.

3.2.2 Digital Financial Inclusion Proxies

As the purpose of this study is to test the effect of DFI on the stability of emerging Asian banks to promote inclusive economic growth, digital financial proxies have been measured using the data from the FAS database over the period 2011 to 2018. In this regard, both the digital financial outreach and usage penetrations have been considered for DFI based on previous studies (e.g., Ahamed and Mallick 2019; Banna and Alam 2020; Banna et al. 2020a; Banna, Hassan, and Alam 2020b). However, the

selection of proxies is different from the previous studies as they considered financial inclusion, whereas this study considers digital financial inclusion. As a part of geographic and demographic outreach penetration (known as "supply side"), the number of ATMs and mobile money agent outlets per 100,000 adults and per 1,000 km^2 have been considered, while the number of mobile money accounts per 1,000 adults and the number of mobile and internet banking transactions per 1,000 adults have been considered as a part of the usage of digital financial service penetration (known as "demand side"). In addition, we consider "Made or received digital payments in the past year (% age 15+)" as a proxy for DFI to discover the robustness of our study. However, due to data unavailability of some DFI components we could not develop a single index of DFI using principal component analysis.

3.2.3 Bank-Specific and Macroeconomic Variables

We control both the bank-specific and macroeconomic variables. Following Fang, Hasan, and Marton (2014), the ratio of total loans to total assets (Loan ratio – B_LR) has been used to account for the liquidity risk of a particular bank. To control the potential size effect and the loan portfolio risk of an individual bank, the study has considered the logarithm of total assets (Bank size – B_SIZE) and the ratio of loan loss provision to total loans (Loan loss provision – B_LLP), respectively. The ratio of other operating income to total operating income (Revenue diversification – B_RD) has been considered to control the ambiguous effect of off-balance sheet activities. Since excessive risk-taking tendency can be reduced by better management quality, the ratio of total earning assets to total assets (Management quality – B_MQ) has been taken into consideration. The equity ratio (Capitalization – B_CAP) has been used to control the capital risk as well-capitalized banks have a lower risk-taking tendency. The Herfindahl-Hirschman Index (B_HHI) has been used for controlling market concentration. The specialization (B_SP – whether an Islamic or conventional bank) and listing (B_LIST – whether the bank is listed with the stock market or not) have also been controlled. This paper uses several macroeconomic variables, such as consumer price index to control inflation (B_INF) and good governance (B_GG) to control institutional effect. A good governance index is constructed using the standardized approach of Kaufmann, Kraay, and Mastruzzi's (2010) governance indicators, which consist of six components, namely Government Effectiveness, Control of Corruption, Regulatory Quality, Political Stability and Absence of Violence/Terrorism, Voice and Accountability, and Rule of Law.

For the economic growth or development proxy, this study uses annual gross domestic product growth (B_GDP), which is also considered as business cycle and economic growth. The interaction between DFI and GDP is considered as an inclusive economic growth or sustainable economic development similarly to Banna and Alam (2020).

Estimation Technique

To examine the impact of DFI and the effect of its interaction with GDP on emerging Asian banking stability, the following baseline regression analysis has been used in this study.

$$Y_{ijt} = \alpha + \beta DFI_{jt} + \gamma Z_{ijt} + \vartheta M_{jt} + \varphi(B\_GDPxDFI)_{j,t} + \varepsilon_{ijt} \quad (3)$$

where, Y_{ijt} = *ln (Z-score)* and *ln(Sharpe ratio)* are dependent variables that are considered as a proxy for bank stability of bank *i* of country *j* in year *t*. DFI_{jt} = the digital financial inclusion proxy in which the individual components of country *j* in year *t* have been considered for the analysis. Z_{ijt} = bank-specific factors of bank *i* of country *j* in

year *t* (such as B_SIZE, B_LR, B_LLP, B_RD, B_MQ, B_CAP, B_HHI, B_SP, and B_LIST*).* M_{jt} = *macroeconomic factors* of country *j* in year *t* (such as B_INF, B_GDP and B_GG). $(B\_GDPxDFI)_{j,t}$ = the interaction effect of GDP and DFI of country *j* in year *t*. $\beta, \gamma, \vartheta, \varphi$ = coefficients of the variables. ε_{ijt} = error term.

Following Alfadli and Rjoub (2019), this study uses the panel-corrected standard errors (PCSE) method of Beck and Katz (1995) to examine the fundamental relationship between the variables. This method is used for two main reasons: a) it minimizes the existing problems of cross-sectional dependency and sequential correlation; b) it determines the likelihood of endogeneity among some of the regressors as well as regress and factors in a certain model using an appropriate instrument (Alfadli and Rjoub 2019). Moreover, following Kim, Batten, and Ryu (2020), the panel two-stage least-squares – instrumental variables (2SLS-IV) method has been used to mitigate possible endogeneity issues for the robustness of the results.

4. RESULTS AND ANALYSIS

The outcomes of the analysis of the relationship between bank stability as well as DFI and the interaction effect with GDP on bank stability are illustrated in this section.

4.1 Digital Financial Inclusion and Bank Stability

4.1.1 Descriptive Statistics

The descriptive statistics of bank stability, B_SIZE, B_LR, B_LLP, B_MQ, B_CAP, B_RD, B_HHI, B_GDP, B_GG, B_INF, and DFI are illustrated in Table 2. The table exhibits the descriptive statistics (mean, standard deviation (SD), and minimum-maximum values) of each variable in the sample. From this table, a few observations are particularly worthy of note. First, the ln (Z-score) has an average value of 4.53 with an SD of 1.48, indicating that to deplete bank equity, on average the ROAA would have to drop by 4.53 times their SD. The SD suggests that every year the level of bank stability varies among the sample countries. Moreover, the mean values of the bank size and SD are 8.61 and 2.32, respectively. Hence, such a high yearly variation can be seen in these results. The sample countries, on average, achieved 6.28% growth in their GDP over the period 2011 to 2018. Furthermore, the sample countries, on average, had 89 and 64 ATMs and mobile money agent outlets per 1,000 km^2 and per 100k adults, respectively. Moreover, the number of mobile money accounts and the number of mobile and internet money transactions per 1,000 adults were approximately 198 and 33,411, respectively.

In order to see the link between bank stability and DFI and the interaction effect of DFI with GDP on bank stability, initially the panel-corrected standard errors regression was considered. The study controls bank-specific variables such as B_SIZE, B_LR, B_LLP, B_MQ, B_CAP, B_RD, and B_HHI and macroeconomic variables such as B_GDP, B_GG, and B_INF for our analysis.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Bank Stability					
Ln (Z-score) using ROAA	2,673	4.533	1.477	–2.748	10.28
Ln (Sharpe ratio) using ROAE	2,470	2.098	1.607	–4.882	8.781
Digital Financial Inclusion (DFI)					
Number of ATMs and mobile money agent outlets per 1,000 km^2	4,592	88.942	84.716	15.907	570.205
Number of ATMs and mobile money agent outlets per 100k adults	4,592	63.737	48.94	8.83	317.035
Number of mobile money accounts per 1,000 adults	2,760	198.218	201.976	.393	855.869
Number of mobile and internet money transactions (during the reference year) per 1,000 adults	2,760	33,411	71,757.85	36.251	400,000
Made or received digital payments in the past year (% age 15+)	4,592	39.892	18.098	7.76	70.42
Bank-Specific					
Bank size (B_SIZE)	3,372	8.61	2.321	–1.941	15.212
Loan ratio (B_LR)	3,354	.532	.174	0	1.747
Loan loss provision ratio (B_LLP)	3,005	.006	.014	–.079	.426
Management quality (B_MQ)	3,367	.839	.1	.006	.997
Capitalization (B_CAP)	3,372	.135	.144	–2.236	.997
Revenue diversification (B_RD)	3,222	29.421	29.239	–178.056	553.863
Herfindahl-Hirschman index (B_HHI)	4,592	.095	.02	.063	.138
Macroeconomic					
Good governance index (B_GG)	4,592	.417	.131	.064	.801
GDP growth (B_GDP)	4,592	6.277	1.493	.84	9.55
Inflation (CPI) (B_INF)	4,592	3.605	2.266	–.9	11.92
Instrumental variables					
Mobile cellular subscriptions (per 100 people) – Mobile Share	4,592	.903	.011	.868	.92
Borrowed from family or friends (% age 15+)	4,592	32.048	7.847	7.65	48.65

Source: Orbis Bank Focus, WDI, and FAS.

We design our analysis based on two main dimensions of bank stability: ln(z-score) (models 1–4) and ln(Sharpe ratio) (models 5–8). Based on DFI, two main penetrations and four subpenetrations, namely financial outreach (both geographic and demographic) penetrations (ATMs and mobile money agent outlets per 1,000 km^2 (models 1 and 5) and per 100k adults (models 2 and 6)) and financial usage penetration of the customers (number of mobile money accounts per 1,000 adults (models 3 and 7) and money transactions per 1,000 adults (models 4 and 8) are designed.

The findings (in Table 3) show that DFI has a positive relationship with emerging Asian banking stability for both the measures of bank stability. The results suggest that a higher level of DFI is significantly related to a higher level of banking stability (a high Z-score and Sharpe ratio indicate greater stability, i.e., less risk taking). Though the usage penetrations have an insignificant positive relationship in most cases, the financial outreach penetrations (both geographic and demographic) have a stronger association with bank stability. This suggests that DFI enriches the soundness of individual banks in the sample countries. These findings are similar to those of previous studies (e.g., Ahamed and Mallick 2019; Banna, Hassan, and Alam 2020b; Morgan and Pontines 2014) that show that a financial system with inclusive DFS tends to strengthen banking stability, and that a greater implementation of DFI reduces the excessive risk-taking tendency of a particular bank.

Table 3: Panel-Corrected Standard-Errors Regression

	Ln (Z-score)				Ln (Sharpe Ratio)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DFI	0.877***	1.389***	0.118	0.457***	0.665***	1.237***	–0.195	0.196
	(0.200)	(0.212)	(0.139)	(0.156)	(0.217)	(0.246)	(0.159)	(0.185)
GDP growth	–0.750***	–1.067***	0.022	0.348*	–0.436*	–0.835***	–0.224	0.015
	(0.214)	(0.151)	(0.127)	(0.200)	(0.237)	(0.185)	(0.146)	(0.245)
DFI*B_GDP	0.129***	0.237***	–0.032	–0.052**	0.082*	0.194***	0.028	–0.006
	(0.045)	(0.035)	(0.026)	(0.024)	(0.048)	(0.042)	(0.030)	(0.029)
B_SIZE	0.198***	0.207***	0.149***	0.166***	0.255***	0.262***	0.265***	0.280***
	(0.021)	(0.021)	(0.030)	(0.030)	(0.022)	(0.021)	(0.031)	(0.031)
B_LR	0.947***	0.988***	0.733	0.640	1.893***	1.926***	1.843***	1.658***
	(0.325)	(0.321)	(0.469)	(0.441)	(0.279)	(0.277)	(0.372)	(0.369)
B_LLP	–27.999***	–27.074***	–26.827***	–26.024***	–71.760***	–69.501***	–70.903***	–66.546***
	(3.840)	(3.687)	(3.648)	(3.548)	(6.963)	(7.015)	(7.819)	(7.660)
B_MQ	0.839**	1.108**	0.464	0.952*	0.118	0.299	–0.023	0.674
	(0.425)	(0.434)	(0.538)	(0.553)	(0.478)	(0.488)	(0.586)	(0.600)
B_CAP	2.635***	2.690***	2.771***	2.746***	–0.623	–0.560	0.042	–0.113
	(0.382)	(0.379)	(0.460)	(0.460)	(0.404)	(0.393)	(0.437)	(0.419)
B_RD	–0.003**	–0.003*	–0.005**	–0.005**	–0.003	–0.003	–0.006*	–0.006*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
B_HHI	7.901**	1.280	0.202	7.987*	1.686	–3.479	–0.124	8.606*
	(3.501)	(2.999)	(4.750)	(4.569)	(3.791)	(3.187)	(5.314)	(4.778)
B_GG	–0.104	0.327	1.045**	0.201	–1.452***	–1.141***	–1.246***	–1.951***
	(0.301)	(0.280)	(0.427)	(0.438)	(0.329)	(0.292)	(0.438)	(0.491)
B_INF	–0.087***	–0.075***	–0.035	0.029	–0.068***	–0.072***	–0.098***	–0.045
	(0.017)	(0.019)	(0.029)	(0.028)	(0.020)	(0.022)	(0.033)	(0.033)
B_SP	0.344*	0.273	0.504**	0.460**	–0.078	–0.102	0.012	–0.026
	(0.176)	(0.175)	(0.203)	(0.202)	(0.195)	(0.195)	(0.234)	(0.229)
B_LIST	0.087	0.102*	–0.013	–0.025	0.064	0.081	0.106	0.094
	(0.061)	(0.060)	(0.076)	(0.075)	(0.067)	(0.066)	(0.087)	(0.086)
Year fixed effect	Included	Included	Included	Included	Included	Included	Included	Included
Country fixed effect	Included	Included	Included	Included	Included	Included	Included	Included
Wald chi^2	355.28***	382.62***	286.90***	307.97***	423.24***	422.79***	247.63***	279.10***
Obs.	2,566	2,566	1,502	1,502	2,381	2,381	1,332	1,332
R-squared	0.177	0.181	0.204	0.213	0.166	0.167	0.163	0.172

Standard errors are in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1.

Number of ATMs and mobile money agent outlets per 1,000 km^2 (models 1 and 5).

Number of ATMs and mobile money agent outlets per 100k adults (models 2 and 6).

Number of mobile money accounts per 1,000 adults (models 3 and 7).

Number of mobile and internet money transactions (during the reference year) per 1,000 adults (models 4 and 8).

However, the insignificant positive effect of usage dimensions of DFI suggests that in the sample countries, banks and other FinTech companies have provided sufficient access to finance but people are still lagging behind in adopting it. This can be explained by the following facts. First, the practice of digital finance among the citizens of the sample countries is at a very early stage and it takes some time to impact significantly on banking stability and consequently the economy as a whole. This is because when a country adopts a new technology, it takes a long drive to reach maturity level or to cope with the existing development patterns (Banna 2020), which is also referred to as “drive to maturity” by the Stages of Economic Growth model of Rostow (1959). Second, this could be due to a lack of financial literacy among people. This is because, to digitalize financial services and bring consumers and businesses under this digitalization, it is necessary to promote and strengthen digital financial literacy among people (Morgan, Huang, and Trinh 2019). Thirdly, BigTech financial

companies dominate the digital financial market by making lucrative offers to their clients (e.g., no credit score required to get loans, consumer finance service facilities, etc.) (Stulz, 2019), which can discourage them from using banking services/products. Fourthly, high-speed or uninterrupted internet, like 3G, 4G, or 5G, which is the latest internet connection, is required for smooth operation of DFI, but this is still unavailable in many countries around the world (Ozili 2018), and the internet facility in some countries is not up to the mark or they have slower internet , resulting in buffering, server down, and network problems, which makes people reluctant to use DFS. Finally, account hacking and ATM card or SIM card cloning (Wyman 2017); forgetting the password of one's own card, E-wallet, or account; data privacy issues; loss of hand phone; and cyber insecurity (Adeoti 2011) may prevent people from using the full-fledged facilities of DFS (Obiano 2009).

The study has found a positive association between economic growth (B_GDP) and banking stability as growth influences banking stability. However, the findings denote that, in most cases, GDP alone is negatively associated with banking stability in emerging Asian countries. But surprisingly, the interaction of DFI and B_GDP has a significantly positive relationship with banking stability. Such findings suggest that when B_GDP is associated with banking stability, it reflects a negative relation. However, when DFI interacts with B_GDP, the relationship with banking stability becomes strong and positive. The effect of interaction of DFI with GDP growth is considered because while talking about the real or inclusive economic growth or sustainable economic development of any country, GDP emerges as one of the main determinants (Banna and Alam 2020; Banna, Hassan, and Alam 2020b). GDP is considered a key indicator for a country's economic sustainability (Ben-David and Papell 1995) and GDP growth, for most countries, means overall economic development. However, for high-income countries, an increase or decrease in GDP does not necessarily have an impact, or has minimal impact, on their economic development. As both GDP and inclusive digital finance determine a country's economic growth, both of their interaction effects are thought to bring inclusive economic growth or sustainable economic development in an increasing manner.

The economic impact of the results, in particular, suggests that inclusive digital finance may help Asian banks lower costs by minimizing manual paperwork and documentation as well as maintaining fewer bank branches (Banna 2020; Banna, Hassan, and Alam 2020b; Manyika et al. 2016). DFI, as an instrument, helps financial and monetary system regulators to reduce the level of inflation in both poor and developing countries by restricting the circulation of the amount of physical cash. Furthermore, DFI plays a significant role in enhancing the welfare of individuals and business sectors through which individuals can easily access funds in their bank accounts to perform financial transactions (CGAP 2015). Therefore, with an inclusive digital financial system, Asian banks enjoy greater financial stability through ensuring sustainable economic development.

In addition, B_SIZE, B_LR, B_LLP, B_RD, B_HHI, B_CAP, B_INF, and B_GG are also significant determinants of banking stability in emerging Asian countries.

4.1.2 Robustness Test: Instrumental Variables

Though possible reverse causality (endogeneity) is a common identification issue in any banking study, this study might be less concerned about endogeneity issues as it investigates the effect of DFI (a country-level indicator) on Asian banking stability (bank-level indicator). Nevertheless, in order to make the results more robust, following Kim, Batten, and Ryu (2020), this study used the 2SLS-IV technique.

We search the recent empirical studies on banking stability and financial inclusion to choose instrumental variables (IVs) in order to address any potential endogeneity issue. Following Ahamed and Mallick (2019), this study considers the proportion of mobile cellular subscriptions (per 100 people) in other countries in the same region as an instrumental variable for the 2SLS-IV technique. We consider countries from the East Asia, Southeast Asia, and South Asia regions. It is argued that banking operational costs as well as physical and financial infrastructural deficiencies can be reduced through good communication infrastructure (Beck, Demirgüç-Kunt, and Martínez-Pería 2007) and mass use of the mobile phone (Allen et al. 2014). Hence, countries with a larger number of mobile subscriptions help to enable unbanked people to be banked, which will not directly affect bank stability but may influence DFI.

In addition to that, we consider the "percentage of adults borrowing from friends and family" as an instrumental variable. It is found that the key source of borrowing money in the developing countries is friends and family (Demirgüç-Kunt and Klapper 2012) and it is also evident that only 9% of adults borrow from formal financial sectors and 29% of adults borrow from friends and family. A higher percentage of adults borrowing from friends and family may influence DFI but does not directly affect bank stability (Ahamed and Mallick 2019).

The 2SLS-IV regression model does not change any result from the above analysis, rather it shows a stronger relationship between DFI and banking stability by providing a higher coefficient (in Table 4). These findings make the PCSE regression results more robust and suggest that an inclusive digital financial system is positively associated with banking stability in emerging Asian countries. The interaction effect of DFI and B_GDP also make the above results more robust, which suggests that accelerating digital finance in the sample countries through ensuring sustainable economic development is a significant way of stabilizing the banking sector.

Apart from this, we also consider "the percentage of adults that made or received digital payments in the past year" as an alternative proxy of DFI from the Global Findex database. The results using an alternative proxy (in Table 5) also make the previous results more robust. Therefore, it is evident that with an inclusive digital financial system, banks enjoy greater financial stability through ensuring sustainable economic development.

Next, we have taken the nonperforming loans ratio (NPL) as an alternative proxy for bank stability. The lower the ratio, the higher the stability – hence, the study finds a negative association between DFI and NPL. The results in Table 6 suggest that DFI has a negative relationship with NPL, which means that DFI positively affects banking stability in emerging Asian countries. Again, the demand side of DFI is insignificant, although the alternative DFI proxy is significant. These findings make the above results more robust and suggest that an inclusive digital financial system is significantly and positively associated with banking stability in emerging Asian countries. The interaction effect of DFI and B_GDP also makes the above results more robust, which suggests that accelerating digital finance in the sample countries through ensuring sustainable economic development is a significant way of stabilizing the banking sector.

Table 4: Instrumental Variables and 2SLS Regression – Robustness

	Ln (Z-score)				Ln (Sharpe Ratio)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DFI	1.800*	2.603***	–3.207**	–2.556**	2.656**	2.975***	–2.886**	–2.392*
	(0.961)	(0.849)	(1.428)	(1.240)	(1.042)	(0.964)	(1.329)	(1.356)
GDP growth	–1.867**	–1.950***	–2.883**	–3.331**	–2.652**	–2.067***	–2.431**	–3.152*
	(0.950)	(0.558)	(1.216)	(1.503)	(1.041)	(0.644)	(1.153)	(1.692)
DFI*B_GDP	0.354*	0.486***	0.625**	0.374**	0.542**	0.503***	0.549**	0.362*
	(0.199)	(0.130)	(0.281)	(0.174)	(0.216)	(0.148)	(0.265)	(0.190)
B_SIZE	0.218***	0.213***	0.133**	0.145***	0.241***	0.240***	0.211***	0.244***
	(0.030)	(0.030)	(0.053)	(0.050)	(0.035)	(0.035)	(0.061)	(0.053)
B_LR	0.757**	0.786**	0.652	–0.211	2.061***	1.948***	2.834***	1.543**
	(0.326)	(0.322)	(0.566)	(0.528)	(0.388)	(0.387)	(0.671)	(0.629)
B_LLP	–20.492***	–19.674***	–19.615***	–19.698***	–72.077***	–71.027***	–79.686***	–81.399***
	(2.044)	(2.040)	(2.438)	(2.365)	(7.533)	(7.320)	(9.213)	(9.081)
B_MQ	1.547**	2.068***	0.267	1.865**	1.029	1.460*	–1.038	0.887
	(0.608)	(0.622)	(0.862)	(0.816)	(0.726)	(0.750)	(1.000)	(0.943)
B_CAP	2.268***	2.215***	2.663***	2.102***	–1.218**	–1.376***	–0.340	–0.863
	(0.435)	(0.432)	(0.717)	(0.640)	(0.517)	(0.516)	(0.830)	(0.725)
B_RD	–0.002	–0.001	–0.004*	–0.005**	0.000	0.000	–0.001	–0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
B_HHI	11.283	0.058	–28.832	–20.638	6.146	0.024	–36.452*	–23.362
	(10.117)	(8.273)	(18.219)	(16.703)	(11.661)	(9.715)	(18.874)	(17.461)
B_GG	1.239	2.079***	3.049***	8.358**	0.852	–0.076	–0.523	4.699
	(0.946)	(0.620)	(0.910)	(3.394)	(1.040)	(0.719)	(0.992)	(3.633)
B_INF	–0.030	–0.014	0.144**	0.090*	–0.030	–0.030	0.006	–0.028
	(0.038)	(0.034)	(0.063)	(0.049)	(0.045)	(0.040)	(0.060)	(0.056)
B_SP	0.115	0.035	0.350	0.833**	–0.552**	–0.524**	–0.497	0.018
	(0.233)	(0.220)	(0.313)	(0.324)	(0.268)	(0.256)	(0.355)	(0.331)
B_LIST	0.148	0.076	0.056	0.050	–0.027	–0.051	0.166	0.126
	(0.104)	(0.099)	(0.158)	(0.150)	(0.113)	(0.109)	(0.174)	(0.149)
Year fixed effect	Included	Included	Included	Included	Included	Included	Included	Included
Country fixed effect	Included	Included	Included	Included	Included	Included	Included	Included
Wald chi^2	276.97***	304.56***	143.35***	155.86***	269.77***	279.91***	134.08***	147.50***
Obs.	1,827	1,827	1,012	1,012	1,669	1,669	867	867
R^2	0.1909	0.1936	0.1224	0.1605	0.1605	0.1624	0.1271	0.1345

Standard errors are in parenthesis. *** *p < 0.01, ** p < 0.05, * p < 0.1*.

DFI:

Number of ATMs and mobile money agent outlets per 1,000 km^2 (models 1 and 5).

Number of ATMs and mobile money agent outlets per 100k adults (models 2 and 6).

Number of mobile money accounts per 1,000 adults (models 3 and 7).

Number of mobile and internet money transactions (during the reference year) per 1,000 adults (models 4 and 8).

Table 5: Alternative DFI Proxy – Robustness

	Ln (Z-score)		Ln (Sharpe Ratio)	
	(1)	(2)	(3)	(4)
DFI	0.035***	0.059**	0.042***	0.058**
	(0.011)	(0.023)	(0.012)	(0.026)
GDP growth	–0.300***	–0.435***	–0.254***	–0.342**
	(0.074)	(0.131)	(0.088)	(0.150)
DFI*B_GDP	0.008***	0.011***	0.007***	0.009**
	(0.002)	(0.004)	(0.002)	(0.004)
B_SIZE	0.182***	0.200***	0.260***	0.261***
	(0.022)	(0.026)	(0.022)	(0.030)
B_LR	1.162***	1.132***	1.980***	2.176***
	(0.329)	(0.274)	(0.277)	(0.324)
B_LLP	–27.557***	–23.740***	–72.006***	–76.551***
	(3.724)	(1.916)	(6.924)	(6.003)
B_MQ	0.489	1.038**	0.057	0.450
	(0.440)	(0.471)	(0.495)	(0.553)
B_CAP	2.658***	2.541***	–0.549	–0.675
	(0.376)	(0.369)	(0.397)	(0.436)
B_RD	–0.003*	–0.003*	–0.003	–0.001
	(0.001)	(0.001)	(0.002)	(0.002)
B_HHI	–2.750	–0.006	–3.510	–0.352
	(3.256)	(4.120)	(3.567)	(4.741)
B_GG	0.573	1.166*	–0.176	0.052
	(0.407)	(0.625)	(0.399)	(0.729)
B_INF	–0.027	–0.016	–0.065***	–0.063***
	(0.021)	(0.020)	(0.024)	(0.023)
B_SP	0.362**	0.283	–0.067	–0.072
	(0.176)	(0.186)	(0.197)	(0.214)
B_LIST	0.067	0.081	0.090	0.090
	(0.061)	(0.084)	(0.067)	(0.095)
Year fixed effect	Included	Included	Included	Included
Country fixed effect	Included	Included	Included	Included
Wald chi^2	394.84***	369.18***	407.53***	334.15***
Obs.	2,566	2,566	2,381	2,381
Pseudo R^2	0.1797	0.1754	0.1622	0.1610

Standard errors are in parenthesis. *** *p < 0.01, ** p < 0.05, * p < 0.1.*

DFI: The percentage of adults that made or received digital payments in the past year.

Panel-corrected standard-errors regression (models 1 and 3).

2SLS-IV regression (models 2 and 4).

Table 6: Alternative Bank Stability Proxy – Robustness

	Dependent Variable: NPL				
	(1)	(2)	(3)	(4)	(5)
GDP growth	5.604***	4.799***	–1.707**	–0.840	3.612***
	(1.812)	(1.483)	(0.721)	(0.930)	(1.265)
DFI1	–9.688***				
	(3.239)				
DFI1 x B_GDP	–1.257***				
	(0.431)				
DFI2		–7.374**			
		(2.869)			
DFI2 x B_GDP		–1.175***			
		(0.366)			
DFI3			–1.111		
			(0.866)		
DFI3 x B_GDP			0.188		
			(0.154)		
DFI4				0.136	
				(0.779)	
DFI4 x B_GDP				–0.001	
				(0.111)	
DFI5					–0.514**
					(0.205)
DFI5 x B_GDP					–0.097***
					(0.031)
Obs.	2,330	2,330	1,357	1,357	1,266
R-squared	0.185	0.185	0.161	0.161	0.169
Control variables	Included	Included	Included	Included	Included
Year Fixed Effect	Included	Included	Included	Included	Included
Country Fixed Effect	Included	Included	Included	Included	Included

Standard errors are in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

DFI1: Number of ATMs and mobile money agent outlets per 1,000 km^2.

DFI2: Number of ATMs and mobile money agent outlets per 100k adults.

DFI3: Number of mobile money accounts per 1,000 adults.

DFI4: Number of mobile and internet money transactions (during the reference year) per 1,000 adults.

DFI5: The percentage of adults that made or received digital payments in the past year.

Finally, we split the sample into two parts, namely Panel A: 2011–2015 and Panel B: 2016–2018, to compare between two time periods. As our findings indicate that the demand side has an insignificant relationship with banking stability, we would like to see whether the present situation has changed due to banks' adoption of the latest FinTech-based technology and the industrial revolution 4.0 effect. The results are presented in Table 7.

Table 7: Split the Sample Based on Time Periods – Robustness

	Dependent Variable: Ln (Z-score)							
	Panel A: 2011–2015				Panel B: 2016–2018			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP growth	–0.417	–0.631***	–0.341**	–0.296	–1.514***	–1.034***	1.337***	0.158
	(0.328)	(0.221)	(0.164)	(0.314)	(0.468)	(0.344)	(0.448)	(0.424)
DFI1	0.975**				1.383**			
	(0.455)				(0.694)			
DFI1 x B_GDP	0.088				0.255**			
	(0.072)				(0.110)			
DFI2		1.093***				1.934***		
		(0.389)				(0.612)		
DFI2 x B_GDP		0.135***				0.233***		
		(0.052)				(0.089)		
DFI3			–0.365*				1.751***	
			(0.219)				(0.477)	
DFI3 x B_GDP			0.054				0.353***	
			(0.034)				(0.095)	
DFI4				–0.109				0.388
				(0.258)				(0.308)
DFI4 x B_GDP				0.028				–0.030
				(0.039)				(0.045)
Obs.	1,116	1,116	714	714	1,381	1,381	788	788
R-squared	0.174	0.171	0.189	0.191	0.206	0.216	0.256	0.247
Control variables	Included	Included	Included	Included	Included	Included	Included	Included
Year Fixed Effect	No	No	No	No	No	No	No	No
Country Fixed Effect	Included	Included	Included	Included	Included	Included	Included	Included

Standard errors are in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results in Table 7 show that during the initial period (2011–2015) of digital finance, the DFI-bank stability nexus was weak, especially the demand side of DFI. However, the nexus has become stronger as time (2016–2018) has passed. The interaction effect of DFI and B_GDP on banking stability was stronger during 2016–2018 than in 2011–2015. This is because the banking sector was undergoing a transformation from being traditional to digitalized together with highly dedicated human capital in the initial stage (Vives 2019)—at that time BigTech companies were dominating (especially in the PRC and India). However, with the passage of time, banks have taken over that dominance by adopting financial technology.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study provides empirical evidence that greater DFI has a significantly positive impact on banking stability, indicating that DFI stabilizes the banking sector and an integrated inclusion of digital finance by the emerging Asian banks is not merely a channel of ensuring banking stability, rather it ensures inclusive and sustainable economic development. Such economic sustainability eventually helps in achieving the SDGs. Therefore, governments, policymakers, standard setters, and regulatory bodies can see DFI as a change agent that can bring about revolutionary development in the overall financial sector of the banking industry. In this regard, the implementation of the following policies can be taken into consideration.

Firstly, digital financial literacy for all should be ensured along with ensuring that people have electronic devices supported by the latest technology and different applications germane to DFI that must have an uninterrupted internet connection. Insufficient or a lack of seamless internet connection may discourage people from enjoying digital financial services. For smooth operation of DFI, financial literacy is a must (Klapper and Lusardi 2020) as our findings also show that countries have sufficient access to DFI, but people cannot utilize it properly because of their lack of financial literacy. So, to make people financially literate, campaigns, seminars, and workshops should be arranged. Then, unbanked people living mostly in rural areas should be encouraged to become banked. As opening an account, in most banks, requires a minimum amount, banks should review this so that poor people can open an account smoothly. Then, banks should provide services through which people can remotely open an account and enjoy all sorts of banking facilities. An awareness campaign regarding the prospects of the use of digital finance should be arranged. Timely DFS (e.g., FinTech using artificial intelligence and machine learning) should be introduced that will enhance banking stability and efficiency, which will spur inclusive economic growth. Such types of DFS will inspire people to be more savings-minded and more savings will lead to sustainable economic growth.

Moreover, banks, in order to tackle the cloning of ATM cards, debit cards, credit cards, hacking, and other technological threats, should implement updated software and a database so that hackers cannot breach the data. To prevent card cloning, banks should launch a money withdrawal facility via scanning a QR code with a mobile phone, which already operates in countries like Singapore, Turkey, and so on. Banks must have a strong team ready with vast and sound technical knowledge to provide clients with an uninterrupted and painless service, which will stimulate people en masse to come under the umbrella of DFI. After all, there will be a strong, independent, proficient, and unbiased regulatory body that will supervise all the activities in terms of DFI and adopt innovative and time-tested policies to make it a successful journey.

Finally, our study has some limitations: for example, we could not compare our findings with banks from other regions and other BigTechs from emerging Asian countries due to data unavailability. Future studies can be extended to compare banks with BigTechs and show how banks collaborate with BigTechs or whether banks themselves improve the digitalization or improve productivity or lower the cost of services.

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