Financial inclusion and financial crisis: arguments, stylized facts and evidence

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Financial inclusion and financial crisis: arguments, stylized facts and evidence

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Abstract

The literature has examined the relationship between financial inclusion and financial stability, but no studies have examined the relationship between financial inclusion and financial crisis. This study examines the effect of financial inclusion on financial crisis using data from 28 countries from 2006 to 2017. Three stylised facts were established based on real world observation. One, the level of financial inclusion, in terms of number of bank depositors, decreases during domestic financial crisis. Two, the level of financial inclusion, in terms of ATM penetration, does not decrease during global and domestic financial crises. Three, the level of financial inclusion, in terms of number of bank branch, decreases during global and domestic financial crises and the contraction is stronger during a domestic financial crisis. Using the panel regression, logit and probit regression estimation methods, the empirical results show that low levels of financial inclusion, measured by fewer bank depositors and fewer bank branches, increase the likelihood that a financial crisis will occur. Low levels of financial inclusion, measured by fewer bank depositors, increase the likelihood that a financial crisis will occur in low financial-inclusion countries. In contrast, greater ATM penetration increases the likelihood that a financial crisis will occur in low financial-inclusion countries. The interaction analyses show that all indices of financial inclusion have a joint positive impact on financial crisis, implying that high levels of financial inclusion increases the likelihood that a financial crisis will occur.

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1. Introduction

This study examines the relationship between financial inclusion and financial crisis to determine the effect of financial inclusion on financial crisis. Broadly speaking, financial inclusion refers to access and use of formal financial services by every member of the population (Allen et al., 2012; Ozili, 2018). The financial inclusion agenda is widely seen as a development policy agenda that aims to bring everyone into the formal financial sector so that everybody can access and use formal financial services to meet their needs and improve their welfare (Allen et al., 2012; Ozili, 2018). Governments, central banks, and regulators around the world have introduced policies, instruments, and institutions to increase financial inclusion in their countries (Ozili, 2021a; Zeqiraj, Sohag and Hammoudeh, 2022).

Despite being a development policy agenda, certain historical events have associated financial inclusion with financial crisis and financial crisis in this context refers to a situation where financial assets suddenly lose their value, banks and other institutions are unable to meet their obligations to their clients, when there is large scale bankruptcy of financial intermediaries and when there is prolonged disturbance to financial markets (Han and Melecky, 2013). The most notable financial crisis is the 2007-2009 global financial crisis. The financial crisis had a more severe effect in countries that have high levels of financial inclusion such as the U.S. and the U.K., while the financial crisis had a milder effect in countries that have low levels of financial inclusion such as in African and Latin American countries (Udell, 2020; Corrado and Corrado, 2015). This observation led researchers to raise some concern about an indirect relationship between financial inclusion and financial crisis as well as concerns that the increasing number of institutions, policies and instruments that promote financial inclusion may give rise to risks that could trigger a financial crisis in countries (García and José, 2016; McLean and Nocera 2010; Anarfo and Abor, 2020).

A growing literature has focused on the relationship between financial inclusion and financial stability where financial stability is a condition in which the financial system which comprises of financial institutions, financial markets and financial infrastructures are functioning well, allocating financial resources efficiently and can withstand shocks of any kind (Brunnermeier et

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al., 2009; Sarlin and Peltonen, 2013). But the literature has not examined explicitly the relationship between financial inclusion and financial crisis. For example, in the financial inclusion-stability literature, Han and Melecky (2013) argue that financial inclusion is linked to financial stability because financial inclusion provides a more diversified funding base for financial institutions through increase in deposits from diverse sources, and it makes financial institutions more resilient to shocks. Morgan and Pontines (2014) and Horn (2010) show that financial inclusion leads to efficient savings intermediation, and it reduces the size of the informal economy which is beneficial for the stability of the financial system. García and José (2016) also show that financial inclusion enables the monitoring and implementation of money-laundering and terrorism-financing laws which is essential for maintaining the integrity and stability of the financial system. While this literature offers some insights on the benefits of financial inclusion for financial stability, it does not offer insights on how financial inclusion might trigger a financial crisis.

Understanding the effect of financial inclusion on financial crisis is important because it can help policymakers to determine whether high levels (or low levels) of financial inclusion is desirable and whether attaining high levels of financial inclusion will make the financial system safer or fragile and susceptible to a financial crisis. Understanding the effect of financial inclusion on financial crisis is also important because it can help policymakers to determine whether too much financial inclusion is a good thing or a bad thing especially when its effect on financial crisis is examined. If the evidence suggest that high levels of financial inclusion lead to financial crisis, it would imply that too much of a good thing (in this case, financial inclusion) is bad. Such insights can help policymakers to reevaluate their national financial inclusion strategy and focus their financial inclusion efforts on determining the 'optimal' level of financial inclusion that should be attained rather than seeking to achieve a 100 percent level of financial inclusion that could expose the financial system to a financial crisis. Motivated by this concern, this study examines the relationship between financial inclusion and financial crisis to determine the effect of financial inclusion on financial crisis.

In the study, six major channels through which financial inclusion triggers a financial crisis were

identified which are limited access to bank deposits, low access to credit, undiversified lending, reckless credit expansion, an existing economic crisis, and over indebtedness. The study also established some stylised facts from observation of real-world data. They include the following. One, financial inclusion, in terms of number of bank depositors, decreases during domestic financial crisis. Two, financial inclusion, in terms of ATM penetration, does not decrease during global and domestic financial crises. Three, financial inclusion, in terms of number of bank branches, decreases during global and domestic financial crises and the contraction is stronger during a domestic financial crisis. Furthermore, the empirical analysis show that low levels of financial inclusion increase the likelihood that a financial crisis will occur particularly in low financial-inclusion countries. It was also found that high levels of financial inclusion increase the likelihood that a financial crisis will occur.

This study contributes to the existing literature that investigate the effect of financial inclusion on financial stability (see., Han and Melecky, 2013; Hannig and Jansen2010; Mehrotra and Yetman, 2015; Sahay et al., 2015), but which have not considered the effect of differing levels of financial inclusion on financial crisis. In this study, it was argued that both low and high levels of financial inclusion can trigger a financial crisis, and this proposition is supported with evidence using available data. This study also contributes to the broad literature that examines the effect of financial inclusion on the broader economic system (e.g., Thornton, 1994; Abosedra and Fakih, 2014; Ozili, 2021; Singh et al, 2023). In contrast, this study focus solely on the effect of financial inclusion on financial crisis.

The article is organised as follows. Section 2 presents the underlying theory. Section 2 also discusses how low levels of financial inclusion may trigger a financial crisis. Section 2 further discusses how high levels of financial inclusion may trigger a financial crisis. Section 3 offers some stylised facts on the relationship between financial inclusion and financial crisis. Section 4 provides some evidence on the effect of financial inclusion on financial crisis. Section 5 presents the conclusion of the study.

2. Understanding the link between financial inclusion and financial crisis

2.1. Theory

Diamond-Dybvig (1983)'s theory of bank runs provides an appropriate framework to understand the relationship between financial inclusion and financial crisis. The theory begins by stating that banks have a contract to provide services to both loan takers and depositors who can demand for their deposits at anytime. The theory states that panic in banking markets can trigger a bank run whenever depositors become anxious about what would happen to their money held in banks (Diamond and Dybvig, 1983). A bank run is a situation when a large number of financially included bank depositors attempt to withdraw their money at the same time over concerns that a bank might fail. When financially-included depositors panic and become anxious, it could lead them to initiate massive deposit withdrawals and such withdrawals would trigger the failure of many banks and lead to a financial crisis or financial instability (Diamond and Dybvig, 1983). The theory establishes a relationship between financial inclusion and financial crisis because it shows that the behaviour of depositors who are financially included can lead to financial crisis.

2.2. Low levels of financial inclusion can lead to financial crisis

This section provides an elaborate discussion on the channels or mechanisms through which financial inclusion leads to a financial crisis. Low levels of financial inclusion are common in poor and developing countries and these countries may experience financial crisis through two channels.

One channel through which low levels of financial inclusion may trigger a financial crisis is low access to credit and undiversified lending. Low access to credit is typical among countries with low levels of financial inclusion. A decrease in the amount of credit to low-end individuals and small and medium scale enterprises (SMEs) by banks will result in banks having an undiversified loan portfolio which in turn would increase the overall riskiness of banks and could lead to bank failure or financial crisis. This view is corroborated by existing studies such as Khan (2011) and Morgan and Pontines (2014) who examined the relationship between financial stability and financial inclusion. They measured financial inclusion by the share of credit to small and medium

sized enterprises (SMEs) and found a direct linear relationship between financial inclusion and the stability of the financial system. Siddik and Kabiraj (2018) also examined the relationship between financial inclusion and financial stability. They measured financial inclusion as the number of SME borrowers to total borrowers and the ratio of outstanding SME loans to total loans. They found that financial inclusion has a positive relationship with financial stability. The result of these studies implies that low levels of financial inclusion in terms of fewer access to credit for SMEs lead to bank fragility and may trigger a financial crisis. Vo, Nguyen and Van (2021) examined the association between financial inclusion and financial market stability in Asian banks and found that fewer access to banking facilities decreases the stability of the banking sector and reduces bank resilience.

Another channel through which low levels of financial inclusion may trigger a financial crisis is limited access to deposits by banks. Low level of financial inclusion could mean that only few people keep their savings in banks as deposits. When there are few savers in the financial system, the banking sector deposit base would be small and undiversified. Therefore, banks would be compelled to increase their reliance on non-core financing which is risky during times of crisis (Khan, 2011). Furthermore, if the deposit base of the banking system is small, the implication is that banks would be susceptible to a bank run as they may not be able to meet unusual deposit demand by depositors during stressed times or they may not have sufficient deposits to use to withstand economic shocks, thereby triggering a banking crisis or financial crisis. This view is corroborated by existing studies such as Han and Melecky (2013) who examined the relationship between financial stability and financial inclusion. They measured financial inclusion using access and use of bank deposits. They found that higher financial inclusion increases the deposit base of banks in times of crises and makes the financial system more stable. Hannig and Jansen (2010) also showed that the inclusion of low-income and disadvantaged adults in the formal financial system increases the deposit base of banks and enable banks to withstand economic shocks. These studies also suggest that low levels of financial inclusion in terms of fewer deposits held in banks can make banks become unstable and may trigger a financial crisis or prolong an existing financial crisis.

2.3. High levels of financial inclusion can lead to financial crisis

High levels of financial inclusion are common in developed countries and these countries may also experience financial crisis through several channels. One channel through which high levels of financial inclusion may trigger a financial crisis is '*reckless credit expansion*'. Many countries often embark on extensive financial inclusion programmes that involve credit expansion to all segments of the population such as the Pradhan Mantri Jan Dhan Yojana (PMJDY) financial inclusion scheme in India. Such efforts often lead to credit inclusion and high levels of financial inclusion. In the quest to accelerate financial inclusion, many financial institutions may lower their lending criteria or credit standards to enable them to give out more loans to individuals and businesses as quickly as possible to generate profit margins. Such reckless credit expansion would lead to significant credit growth, increase credit risk and could lead to a financial crisis (Mehrotra and Yetman (2015). Other risks may rise from rapid credit growth associated with new financial inclusion institutions and instruments and from unregulated parts of the financial system (García and José, 2016). These risks could increase the fragility of the financial system. Lack of supervision of bank lending practices during periods when credit is expanded to everyone will further exacerbate credit risk in the financial system and trigger a financial crisis (Sahay et al., 2015). Feghali, Mora and Nassif (2021), in a cross-country study, examined the relationship between financial inclusion, bank market structure, and financial stability. They argued and found evidence that greater access to credit, or credit inclusion, weakens financial stability especially if credit growth is reckless and without due regard to borrower's ability-to-repay.

A real-world example of how reckless credit expansion lead to a financial crisis is the case of Sri Lanka in 2022[1]. Sri Lanka had a high debt profile before the COVID-19 pandemic. The external shocks from the COVID-19 pandemic and the Russia-Ukraine war led to a political, economic and social crisis in Sri Lanka. Sri Lanka was in desperate need of foreign currency to import basic goods. Banks were in turmoil, and the country could not undertake further borrowing because it had reached its limit on borrowing. 54 percent of Sri Lankan households were indebted. As a result, Sri Lanka defaulted on its foreign debt. This led to a sudden uprising and a subsequent

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[1] https://www.cadtm.org/spip.php?page=imprimer&id_article=22355

change of government. The IMF offered austerity measures to Sri Lanka, but these measures had a spill over effect to private households and women were worse hit by the debt crisis.

Another channel through which high levels of financial inclusion may trigger a financial crisis is when there is an '*existing economic crisis*'*.* An economic crisis may trigger a financial crisis even in the most financially inclusive countries. Countries that have high levels of financial inclusion may experience financial crisis if there is a widespread economic crisis that make depositors become anxious about the safety of their bank deposits. This is because, in times of economic crisis, bank depositors will become anxious about the safety of their money held in banks. Their anxiety could lead them to initiate a run on banks. This would lead to massive withdrawal of deposits out of all banks. Although deposit withdrawals are expected to be lower if bank deposits are diversified and when there is deposit insurance coverage, a large number of depositors may panic and their insistence to withdraw their money at the same time can trigger contagion and lead to liquidity crisis in the banking system. The correlated withdrawal of bank deposits at the same time would lead to bank failure and a financial crisis (Han and Melecky, 2013).

Another channel through which high levels of financial inclusion may trigger a financial crisis is '*over indebtedness'*. Debt instruments such as credit cards are commonly used to promote credit inclusion and financial inclusion in developed countries that have high levels of financial inclusion such as the U.S. and U.K. The ease of access to a credit card and other debt instruments in these countries entice people to take more loans than they can repay. While the debts are recorded as assets on the balance sheet of banks, these assets can be easily impaired when unforeseen events (such as the COVID-19 pandemic) make it difficult for debtors to repay. When debtors begin to default and there is no government guarantee for these loans, banks will bear huge losses that could lead to the failure of affected banks and the failure of one bank may trigger the failure of other banks, thereby leading to a banking crisis.

3. Some stylized facts

This section analyzes country-level real world data to determine the trend in some crucial financial inclusion indicators in times of crisis and to develop some stylised facts using data obtained from the World Bank's Global Financial Development indicators. The charts figure 1 below report some financial inclusion indicators in crisis years (in red colour) and in non-crisis years (in blue colour).

The charts show that the number of bank depositors (i.e., bank accounts per 1,000 adults) decreased significantly during domestic financial crises as shown in the case of Moldova and Ukraine. Interestingly, the number of bank depositors did not decrease significantly during the global financial crisis as shown in the case of Latvia, Nigeria, and Ukraine. One stylised fact to draw from this is that the level of financial inclusion, in terms of number of bank depositors, decreases during a domestic financial crisis, but this effect is either non-existent or minimal during a global financial crisis. The charts also show that many countries witnessed an increase in the number of ATMs during global and domestic financial crises as shown in the case of Guinea Bissau, Latvia, Moldova, Nigeria, Ukraine, Austria, and France. However, there were few exceptional cases where the number of ATM decreased as shown in the case of Belgium, Cyprus, and Denmark. One stylised fact to draw from this is that the level of financial inclusion, in terms of ATM penetration, does not decrease significantly during global and domestic financial crises. The charts further show that many countries witnessed a decrease in commercial bank branches during global and domestic financial crises as shown in the case of Latvia, Moldova, Nigeria, Ukraine, Belgium, Cyprus, Denmark, and France. One stylised fact to draw from this is that the level of financial inclusion, in terms of bank branches, decreases during global and domestic financial crises and the decrease in commercial bank branches is more severe during a domestic financial crisis than during a global financial crisis.

Figure 1: Financial inclusion indicators during crisis: country specific examples

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Denmark

France

Greece

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Nigeria

Ukraine
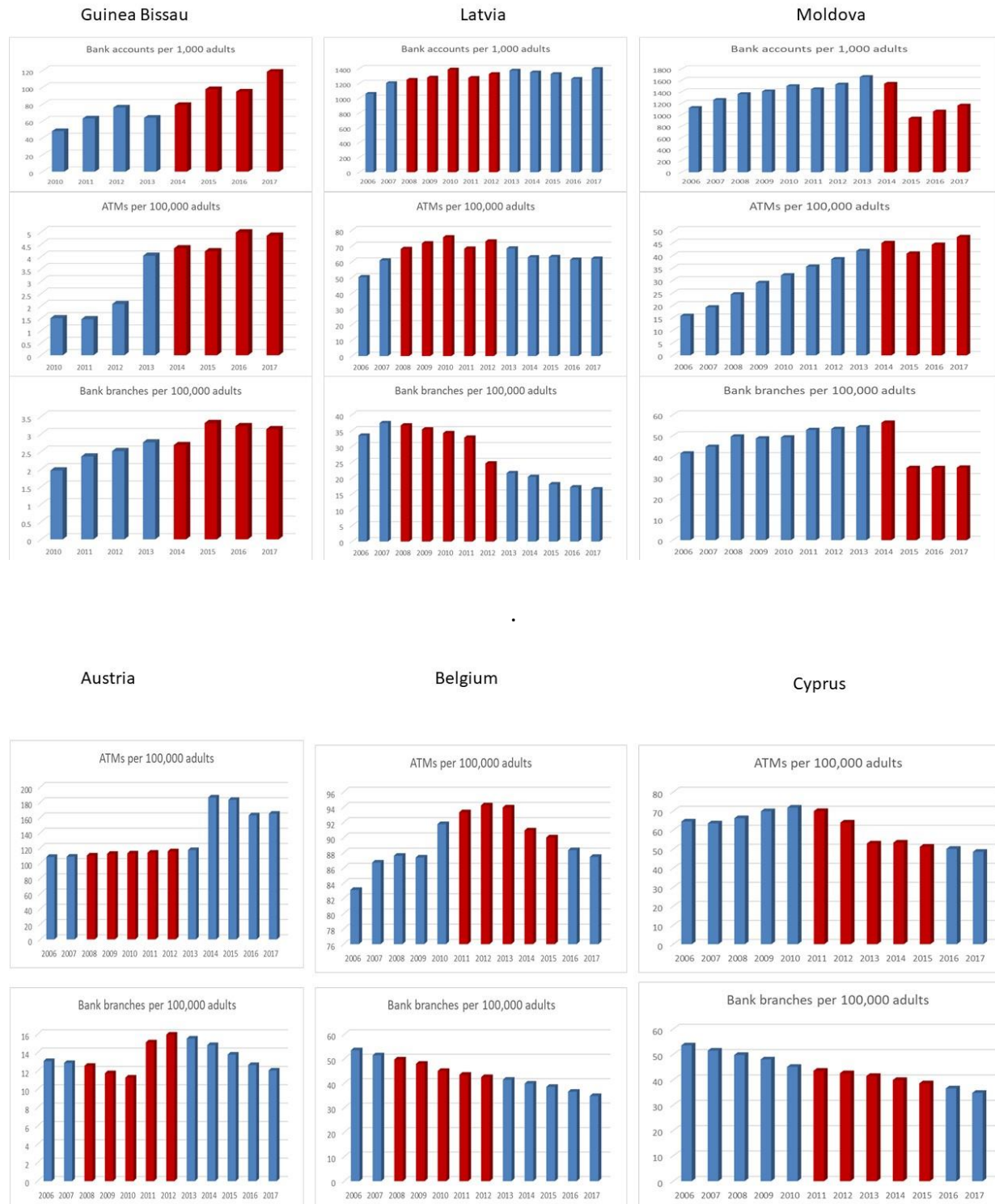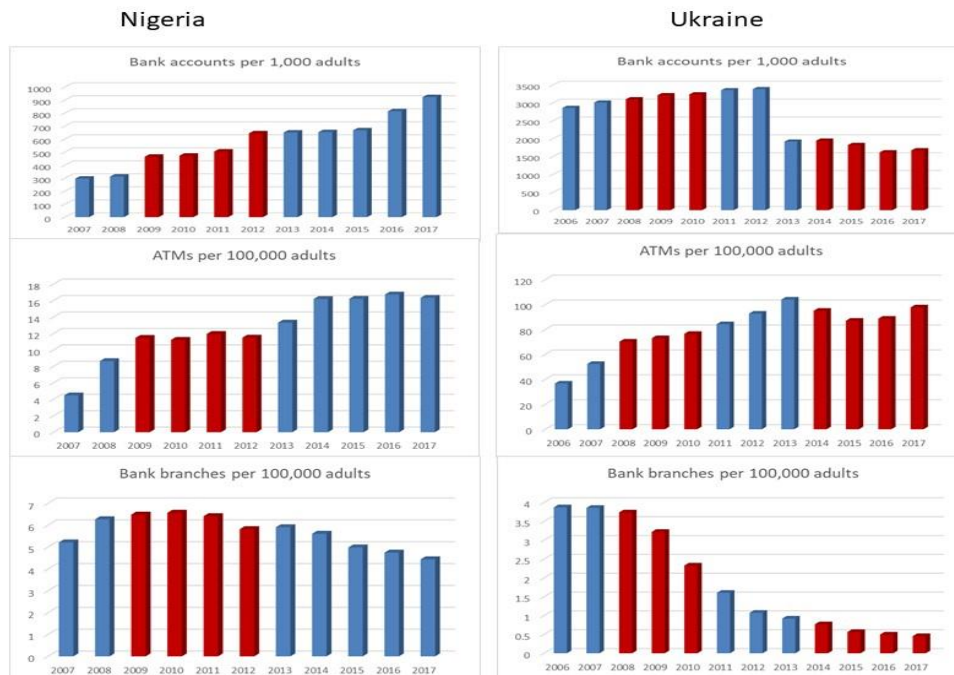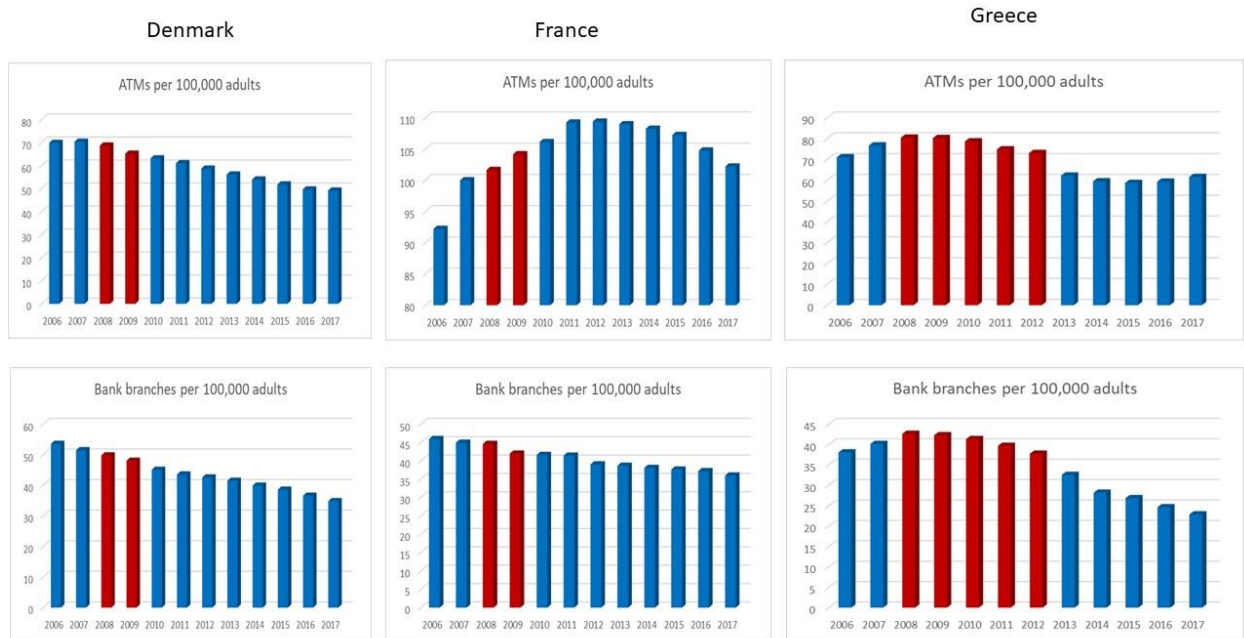
Source: World Bank Global Financial Development Indicators

4. Methodology

4.1. Data

Twenty-eight (28) countries were analysed namely Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Mongolia, Netherlands, Portugal, Russian Federation, Spain, Sweden, Switzerland, the United Kingdom, the United States, Guinea-Bissau, Kazakhstan, Latvia, Moldova, Nigeria, Slovenia, and Ukraine. The 28 countries were selected based on data availability. The data were obtained from the World Bank's Global Financial Development Indicators (GFDI). The sample is an unbalanced panel data of 28 countries. The sample period covers the 2006 to 2017 period. The reason for selecting the 2006 to 2017 sample period is to capture the periods of significant banking crises in most countries. The variable description is presented in table 1.

Table 1. The variables used in the study			
Variable symbol	Indicator Name	Short definition	Source
BAC	Bank accounts per 1,000 adults	Number of depositors with commercial banks per 1,000 adults.	GFDI
ATM	ATMs per 100,000 adults	Number of automated teller machines (ATMs) per 100,000 adults.	GFDI
BR	Bank branches per 100,000 adults	Number of commercial bank branches per 100,000 adults.	GFDI
ZS	Bank Z-score	It captures the probability of default of a country's commercial banking system.	GFDI
BS	Banking crisis dummy variable (1=banking crisis, 0=none)	Dummy variable for the presence of banking crisis (1=banking crisis, 0=none)	GFDI

4.2. Empirical model

The empirical model employed to estimate the effect of financial inclusion on financial crisis is a modified form of the models used in Han and Melecky (2013), Sahay et al (2015) and Ozili (2023). The model is also hinged on the Diamond-Dybvig (1983)'s theory of bank runs which show that the behaviour of financially-included depositors can lead to financial inclusion. The equations, Eq. (1) and (2), estimate the effect of financial inclusion on financial crisis.

$$BC_{i,t} = \beta_o + \beta_1 BAC_{i,t} + \beta_2 ATM_{i,t} + \beta_3 BR_{i,t} + \beta_4 (BAC * ATM * BR)_{i,t} + \varepsilon_{i,t} \ldots\ldots. Eq.1$$

$$ZS_{i,t} = \beta_o + \beta_1 BAC_{i,t} + \beta_2 ATM_{i,t} + \beta_3 BR_{i,t} + \varepsilon_{i,t} \ldots\ldots. Eq.2$$

Where i, t represents country and year. The BC variable is the financial crisis dependent variable and is measured using the banking crisis dummy variable. The ZS variable is an alternative measure of financial crisis and is measured using the z-score. The BAC variable is the number of depositors with commercial banks per 1,000 adults. The ATM variable is the number of automated teller machines per 100,000 adults. The BR variable is the number of commercial bank branches per 100,000 adults. ε_{it} is the error term of the model.

4.3. Estimation procedure

Regarding the estimation procedure, the models are estimated using three estimation methods namely the panel fixed effect regression method, logistic (logit) regression and probit regression methods. The logit and probit regression estimation methods are appropriate for this study because they are commonly used when the dependent variable in a regression model is a dummy variable, or in situations where the dependent variable can take only two values. In this study, the BC variable presents a similar case where the dependent variable is equal to one if a banking crisis occurred in a specific year and zero if a financial crisis did not occur in the same year. The panel fixed effect regression model is also used to estimate the model to control for all time invariant omitted variables that are difficult or impossible to observe.

4.4. Justification of the variables

Next, I proceed to justify the variables included in the empirical model. The BC variable is the main financial crisis dependent variable. The BC variable takes a value of one in the year where a

financial crisis occurred in a country and takes a value of zero in the year where a financial crisis did not occur. The z-score is an alternative financial crisis dependent variable. Many studies use the bank z-score to measure banking crisis or bank stability (Lee and Hsieh, 2013; Ozili, 2024). A high z-score indicates that the banking system is very distant from systemic default or distant from a financial crisis, which means the banking system is stable (Ozili, 2024).

The financial inclusion variables are the BAC, BR, and ATM explanatory variables. These variables are widely used as measures of financial inclusion in the literature (see, for example, Tuesta et al, 2015; Aggarwal, 2014; Sharma, 2016). Regarding the BAC variable, it represents bank accounts per 1,000 adults. It is measured as the number of depositors with commercial banks per 1,000 adults. High values of the BAC variable indicate high levels of financial inclusion. It is widely acknowledged that high levels of financial inclusion exist when the banking sector has a large and diverse number of bank depositors (Han and Melecky, 2013). However, a banking sector that has very few depositors may experience a banking crisis because it has a small deposit base and may not be able to withstand unforeseen shocks arising from massive deposit withdrawals or shocks from a pandemic, economic crisis or war. Therefore, a negative relationship between the BAC variable and the BC variable is predicted.

The BR variable represents bank branches per 100,000 adults. It is measured as the number of commercial bank branches per 100,000 adults. High values of the BR variable indicate high levels of financial inclusion. Existing studies show that commercial banks are important agents of financial inclusion due to their ability to expand and open branches in rural and urban locations (Baza and Rao, 2017; Tuesta et al, 2015). However, the presence of few bank branches may trigger a banking crisis because few bank branches means that there will be fewer customer patronage and fewer depositors in such banks, thereby increasing the risk of a banking crisis. Therefore, a negative relationship between the BR variable and the BC variable is predicted.

The ATM variable represents the number of automated teller machines (ATMs) per 100,000 adults. High values of the ATM variable indicate high levels of financial inclusion. Existing studies show that ATM penetration is used to accelerate financial inclusion (Nuzzo and Piermattei, 2020; Ozili, 2021b). However, the presence of ATMs may play a role in causing a banking crisis especially

when depositors use ATMs to withdraw as much money as they can when there is panic in banking markets. ATMs may also play a role in preventing a banking crisis especially when ATMs are used to meet the deposit withdrawal needs of depositors, thereby reducing the likelihood of a bank run and a banking crisis. Given this conflicting expectation, I do not have a definite prediction for the effect of the ATM variable on the BC variable.

4.5. Summary statistics

In the summary statistics in table 2, the mean value for bank accounts per 1,000 adults (BAC) variable is 1,112.22 while the median is 1,034. The mean value is closer to the median value which indicates that the BAC dataset has a symmetrical distribution, or the BAC variable has a near-zero skewness. A similar observation is found for the banking crisis (BC) variable and the z-score variable (ZS). Meanwhile, the ATM and BR variables have divergent means and median variable.

Table 2. Summary statistics for the variables					
	ATM	BAC	BC	BR	ZS
Mean	119.59	1112.22	0.32	54.21	13.99
Median	87.12	1034.29	0.00	36.08	10.74
Maximum	939.21	3383.35	1.00	511.73	57.44
Minimum	1.46	25.84	0.00	0.38	-0.32
Std. Dev.	168.13	833.83	0.46	83.15	10.53
Skewness	3.80	1.10	0.76	3.97	1.22
Kurtosis	16.71	4.12	1.58	19.68	4.24
Jarque-Bera	3288.49	19.41	60.78	4722.91	100.37
Probability	0.00	0.00	0.00	0.00	0.00
Observations	321	76	336	332	317

4.6. Pearson correlation

The Pearson correlation between the dependent variables and the independent variables reported in table 3 show that the correlation coefficients are all below 0.40 which suggest that multi-collinearity is not a problem in the empirical analysis. The BR variable has a significant negative correlation with the BC variable. This indicates that bank branch contraction is correlated with the occurrence of banking crisis. The BAC variable has a positive correlation with the BC variable. This indicates that higher number of bank depositors is correlated with the

occurrence of banking crisis. The ATM variable has a positive correlation with the BC variable. This indicates that higher number of automated teller machines is correlated with the occurrence of banking crisis.

Table 3. Correlation of the variables (full sample Pearson correlation)

Variable	BC	BAC	ATM	BR
BC	1.000			

BAC	0.062	1.000		
	(0.60)	-----		
ATM	0.009	0.502***	1.000	
	(0.93)	(0.00)	-----	
BR	-0.233**	-0.095	0.283**	1.000
	(0.04)	(0.42)	(0.02)	-----

***,** represent statistical significance at the 1 and 5 percent levels.

5. Empirical Result

5.1. Effect of financial inclusion on financial crisis

Table 4 presents the results for the individual and joint effect of the three financial inclusion variables (BAC, ATM and BR) on financial crisis measured as the occurrence of a banking crisis (BC).

The ATM coefficient is 0.010, 0.006 and 0.004 in estimations (1), (2) and (3) respectively. They are statistically insignificant. The BAC coefficient is 0.0001 and 0.0003 and are also statistically insignificant in estimations (2) and (3) respectively. The BR coefficient is 0.007 and is also statistically insignificant in estimations (1).

Regarding the significant results, the BAC coefficient in estimations (1) and (4) is significant and negatively related to the BC variable. This indicates that low levels of financial inclusion measured by fewer number of bank depositors significantly increases the likelihood that a banking crisis will

occur. The result implies that low levels of financial inclusion will make a banking crisis more likely to occur. The BR coefficient is significant and negatively related to the BC variable in estimations (2) to (6). This indicates that low levels of financial inclusion measured by fewer bank branches significantly increases the likelihood that a banking crisis will occur. This implies that low levels of financial inclusion will make a banking crisis more likely to occur. Although the BAC and BR coefficients are not economically significant, the coefficients are statistically significant. The significant results for the BAC and BR variables support the argument in the literature that low levels of financial inclusion leaves banks with a low deposit base which would make it difficult for banks to withstand economic shocks and could lead to bank failure and a financial crisis. The results support the findings of Khan (2011), Han and Melecky (2013) and Hannig and Jansen (2010). In the interaction analysis, the joint coefficient, BAC*ATM*BR, has a significant positive relationship with the BC variable in estimations (4) to (6). This indicates that high levels of financial inclusion can also make a banking crisis more likely to occur.

	(1)	(2)	(3)	(4)	(5)	(6)
Table 4. Effect of financial inclusion on financial crisis (BC)						
	Panel fixed effect regression	LOGIT regression	PROBIT regression	Panel fixed effect regression	LOGIT regression	PROBIT regression
Explanatory variables	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
c	0.115	-0.219	-0.137	0.952	0.166	0.098
	(0.86)	(0.68)	(0.41)	(0.19)	(0.77)	(0.79)
BAC	-0.0004*	-0.0001	0.0003	-0.0006**	-0.0001	-0.0001
	(0.09)	(0.90)	(0.93)	(0.01)	(-0.29)	(0.81)
ATM	0.0101	0.006	0.004	0.007	-0.002	-0.001
	(0.35)	(0.55)	(0.56)	(0.52)	(0.89)	(0.86)
BR	0.007	-0.029**	-0.018**	-0.041*	-0.093**	-0.054**
	(0.59)	(0.05)	(0.45)	(0.09)	(0.04)	(0.03)
BAC*ATM*BR	-	-	-	0.00001**	0.00001*	0.00001*
				(0.02)	(0.10)	(0.10)
Adj R^2	13.40			45.32		
F-Statistic	1.523			1.846		
LR statistic		4.52	4.57		7.43	7.44
*, ** denote statistical significance at the 10% and 5% levels.						

5.2. Further analysis

5.2.1. Effect in low financial-inclusion countries

In a further analysis, the sample was divided into two subsamples. The first subsample include countries that have low levels of financial inclusion while the second sub-sample include countries that have high levels of financial inclusion. This section presents the estimation for the low financial-inclusion countries which includes Guinea-Bissau, Kazakhstan, Latvia, Moldova, Nigeria, Slovenia, and Ukraine.

The result in table 5 shows that the BR coefficient is statistically insignificant in estimations (1) to (3). The BAC coefficient is 0.0003 and is also statistically insignificant in estimation (1). The ATM coefficient is 0.0101 and is also statistically insignificant in estimation (1). These results suggest that independent changes in the number of bank depositors, bank branches and ATM penetration do not have a significant effect on financial crisis in low-financial inclusion countries. In the interaction result in estimations (4) to (6), the BAC*ATM*BR coefficient is statistically insignificant in the logit and probit estimations in columns (5) to (6).

Regarding the significant results, the BAC coefficient in estimations (2), (3), (4) and (6) is significant and negatively related to the BC variable. The result shows that low levels of financial inclusion measured by fewer number of bank depositors significantly increases the likelihood that a banking crisis will occur in countries that have low levels of financial inclusion. The result implies that a banking crisis is likely to occur in countries experiencing low levels of financial inclusion particularly when there are few number of depositors in the banking system. The ATM coefficient is significant and positively related to the BC variable in estimations (2) and (3). The result indicates that high levels of financial inclusion measured by greater automated teller machine penetration increases the likelihood that a banking crisis will occur. The result implies that greater financial inclusion can also make a banking crisis more likely to occur. Although the BAC and ATM coefficients are not economically significant, the coefficients are statistically

significant. The significant results for the BAC and ATM variables above supports the argument in the literature that low levels of financial inclusion leaves banks with a low deposit base which would make it difficult for banks to withstand economic shocks and could lead to bank failure or a financial crisis (see. Khan, 2011; Han and Melecky, 2013; Hannig and Jansen, 2010). The joint coefficient, BAC*ATM*BR, also has a significant positive relationship with the BC variable in estimation (4). This indicates that high levels of financial inclusion can also make a banking crisis more likely to occur.

	(1)	(2)	(3)	(4)	(5)	(6)
Table 5. Effect of financial inclusion on financial crisis (BC) in low financial-inclusion countries						
	Panel fixed effect regression	LOGIT regression	PROBIT regression	Panel fixed effect regression	LOGIT regression	PROBIT regression
Explanatory variables	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
c	0.151	-0.315	-0.198	0.897	-0.049	-0.026
	(0.83)	(0.57)	(0.57)	(0.23)	(0.94)	(0.94)
BAC	-0.0003	-0.0008*	-0.0005*	-0.0005**	-0.0008	-0.0005*
	(0.23)	(0.08)	(0.07)	(0.04)	(0.11)	(0.09)
ATM	0.0101	0.034**	0.021**	0.007	0.024	0.015
	(0.43)	(0.02)	(0.019)	(0.55)	(0.16)	(0.14)
BR	0.013	-0.016	-0.0101	-0.039	-0.059	-0.037
	(0.43)	(0.33)	(0.31)	(0.14)	(0.19)	(0.17)
BAC*ATM*BR	-	-	-	0.00001**	0.00001	0.00001
				(0.02)	(0.29)	(0.27)
Adj R^2	7.78			18.65		
F-Statistic	1.25			1.65		
LR statistic		6.53	6.62		7.71	7.93

*, ** denote statistical significance at the 10% and 5% levels. The panel fixed effect estimation includes country and year fixed effects.

5.2.2. Effect in high financial-inclusion countries

This section presents the estimation for the high financial-inclusion countries which include Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Mongolia, Netherlands, Portugal, Russian Federation, Spain, Sweden, Switzerland, the United Kingdom and the United States. The result in table 6 shows that the BR coefficient is statistically insignificant in estimations (1) to (3). The BAC and ATM coefficients are also statistically insignificant in estimations (1-3). These results suggest that independent changes in the number of bank depositors, bank branches and ATM penetration do not have a significant effect on financial crisis in high-financial inclusion countries. In the interaction result in estimations (4) to (6), the BAC*ATM*BR coefficient is statistically insignificant in the three estimations, implying that joint changes in the number of bank depositors, bank branches and ATM penetration do not have a significant effect on financial crisis in high-financial inclusion countries. This implies that the earlier results in section 4.2. are not persistent or pronounced in high financial-inclusion countries and the result does not support the findings of Khan (2011), Han and Melecky (2013) and Hannig and Jansen (2010).

<div align="center">(See. appendix for table 6)</div>

5.2.3. Alternative measure of banking crisis

In a separate analysis, an alternative dependent variable – the z-score – was used to measure banking crisis. The z-score is commonly used in the literature to measure banking stability or banking instability (Han and Melecky, 2013; Hannig and Jansen, 2010; Mehrotra and Yetman, 2015; Sahay et al., 2015). Low values of the z-score represent the presence of banking crisis while high values of the z-score represent absence of banking crisis.

The result in table 7 shows that the BR coefficient is statistically insignificant in high financial-inclusion countries in estimation (3). The ATM and BAC coefficients are statistically insignificant in estimations (1-3). Regarding the significant results, the BR coefficient in estimations (1) and (2) is significant and negatively related to the ZS variable. This indicates that high levels of financial inclusion measured by higher number of bank branches increases the risk of a banking crisis (as

indicated by a lower z-score) especially in low financial-inclusion countries. The result implies that elevated levels of financial inclusion can make a banking crisis more likely to occur in low financial-inclusion countries. The negative sign for the BR coefficient is inconsistent with the result obtained in Nguyen and Du (2022) who found that high levels of financial inclusion has a positive effect on the z-score index in their study. The ATM and BAC coefficients are statistically insignificant.

	(1)	(2)	(3)
	Full sample	Low financial-inclusion countries	High financial-inclusion countries
Explanatory variables	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
c	12.190***	13.127***	4.678
	(0.00)	(0.00)	(0.89)
BAC	0.0003	-0.0001	-0.003
	(0.67)	(0.84)	(0.86)
ATM	-0.0005	-0.029	0.176
	(0.99)	(0.38)	(0.71)
BR	-0.120**	-0.119**	-0.106
	(0.01)	(0.01)	(0.83)
BAC*ATM*BR	-	-	-
Adj R^2	92.19	93.27	76.74
F-Statistic	37.04	36.92	5.39

Table 7. Effect of financial inclusion on financial crisis (z-score)
Panel fixed effect estimation

*, ** denote statistical significance at the 10% and 5% levels.

The panel fixed effect estimation includes country and year fixed effects.

6. Conclusion

This study examined the relationship between financial inclusion and financial crisis. The study aimed to determine the effect of financial inclusion on financial crisis using data from 28 countries during the 2006 to 2017 period. Three stylised facts were established in the study. One, financial inclusion, in terms of number of bank depositors, decreases during domestic financial crisis. Two, financial inclusion, in terms of ATM penetration, does not decrease during global and domestic financial crises. Three, financial inclusion, in terms of number of bank branches, decreases during global and domestic financial crises and the contraction is stronger during a domestic financial crisis.

In the empirical analysis, the data were estimated using the panel regression, logit and probit estimation methods. The empirical results showed that low levels of financial inclusion, measured by fewer bank depositors and fewer bank branches, increase the likelihood that a financial crisis will occur. Low levels of financial inclusion, measured by fewer bank depositors, increase the likelihood that a financial crisis will occur in low financial-inclusion countries. In contrast, greater ATM penetration increases the likelihood that a financial crisis will occur in low financial-inclusion countries. The interaction analyses showed that all indices of financial inclusion have a joint positive impact on financial crisis, implying that greater financial inclusion increases the likelihood that a financial crisis will occur.

The findings have important policy implications. First, the findings offers insights to policymakers and economists in determining whether too much financial inclusion is a good thing or a bad thing. The evidence from this study suggest that high levels of financial inclusion can lead to financial crisis, implying that too much of a good thing (in this case, financial inclusion) is bad. This insight can help policymakers to reevaluate their financial inclusion strategy and focus on determining the 'optimal' level of financial inclusion that should be attained rather than seeking to achieve a 100 percent level of financial inclusion which could trigger a financial crisis. Two, policymakers may introduce safeguards to prevent a financial crisis while striving to increase the level of financial inclusion. Policymakers should be mindful that the safeguards introduced to prevent a financial crisis may become a setback to financial inclusion. Therefore, policy makers

should carefully choose anti-crisis measures that will not hinder financial inclusion. They should promote financial inclusion in a way that complement efforts to prevent a financial crisis. Three, policy makers should also anticipate some tradeoffs when deciding whether to focus on reforms to accelerate financial inclusion or whether to focus on reforms to prevent future financial crisis.

Some suggested areas for future research include the following. Future studies can access how financial development might lead to financial crisis. Future studies can also examine whether financial stability has a non-linear relationship with financial inclusion. Further studies can examine whether effective financial regulation and supervision contribute to financial crisis.

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Appendix

Table 6. Effect of financial inclusion on financial crisis in high financial-inclusion countries

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel fixed effect regression	LOGIT regression	PROBIT regression	Panel fixed effect regression	LOGIT regression	PROBIT regression
Explanatory variables	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
c	3.033 (0.70)	24.280 (0.61)	16.452 (0.58)	-35.428 (0.45)	-31.057 (0.83)	-19.571 (0.82)
BAC	0.001	-0.0007	-0.004	0.026	0.037	0.025

	(0.79)	(0.59)	(0.57)	(0.39)	(0.73)	(0.70)
ATM	-0.021	-0.303	-0.220	0.335	-0.082	-0.073
	(0.85)	(0.70)	(0.66)	(0.45)	(0.93)	(0.89)
BR	-0.062	-0.0701	-0.052	0.171	1.079	0.678
	(0.59)	(0.79)	(0.76)	(0.56)	(0.71)	(0.68)
BAC*ATM*BR	-	-	-	-0.00001	0.0002	0.00001
				(0.41)	(0692)	(0.66)
R^2	70			77.06		
F-Statistic	0.781			0.775		
LR statistic		4.403	4.49		4.60	4.72

*, ** denote statistical significance at the 10% and 5% levels.

The panel fixed effect estimation includes country and year fixed effects.