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*Corresponding author: Yawovi M. A. Koudalo, Faculty of Economics and Management, University of Lomé, Lomé 01 BP 1515, Togo
E-mail: koudgodwin@smail.swufe. edu.cn

FINANCIAL ECONOMICS | RESEARCH ARTICLE

Does financial inclusion promote financial stability? Evidence from Africa

Yawovi M. A. Koudalo[1]* and Moumbark Toure[2]

Abstract: This study aims to examine the impact of financial inclusion on financial stability across 54 African countries. Using country-level data that spans a 20-year period from 2000 to 2020, the findings suggest a positive association between the level of account penetration and financial stability. This conclusion withstands several tests of robustness performed. Furthermore, the analysis identifies income inequality, political stability and financial openness as influential factors that may condition the relationship between financial inclusion and financial stability. The implications of our findings suggest the need for increased collaboration between regulatory and supervisory agencies in African countries to promote greater financial inclusion, as policies aimed at improving financial inclusion should have the potential to enhance financial stability. It should be noted, however, that the extent to which financial inclusion should be pursued in order to achieve these goals remains an open question that requires further investigation. Future research could also explore the key barriers to financial access, as identifying these obstacles would enable policymakers to set priorities for action and allocate resources more effectively.

Subjects: Statistics for Business, Finance & Economics; International Finance; Development Economics

Keywords: Financial inclusion; financial stability; financial institutions; risk; African countries

JEL Claasification: G21; G28; O55

1. Introduction

Access to finance for all is a major issue for the development of an economy. It allows individuals to develop their projects thus integrate better into society, enables businesses to invest, innovate and hire, and promotes the proper functioning of the economy as a whole. African countries have always been trying to cope with the difficult fundraising process to finance themselves in order to

PUBLIC INTEREST STATEMENT

The study mainly looked at the impact of financial inclusion such as account, loan and saved at a financial institution, and how the trio help enhance financial stability in Africa. Overall, the study highlights the potential benefits of financial inclusion in promoting financial stability in African countries, and provides insights into the contextual factors that could influence this relationship namely income inequality political stability and financial openness. It is thus important that policy measures to improve financial inclusion have the effect of enhancing financial stability, for the ultimate benefit of the economy.

respond to the major financial issues they encounter. One of the African continent's major challenges is therefore financial inclusion. With the highlighting of the lack of financial inclusion in Africa, this subject has gradually become a priority for policy-makers. Recent research reports on financial inclusion have shown that in Africa, most individuals and businesses suffer from a lack of access to financial products and services. A comparative study (with other developing countries) related to financial inclusion indicates that there are significant differences for Africa between the expected and observed levels of financial development and inclusion (Allen et al., 2014). At the same time, a better understanding of the links between financial inclusion and development has increased interest in developing financial inclusion programs in Africa and elsewhere (World Bank, 2014).

Financial stability is also just as important because it is one of the main factors in price stability and also has other positive effects on the real economy in the sense that it helps build confidence in the system and prevents phenomena such as bank runs that can destabilize a country. Financial stability has become a major concern at the global level. The main reasons for this concern are the multiplication of financial crises from the end of the 1980s to the present day, in particular the latest subprime crisis that began in 2007 in the US (Eross et al., 2015) and spread quickly around the world revealed that regulatory mechanisms of financial systems are ill-equipped to contain hazardous excesses of financial institutions and that institutions whose difficulties could spread throughout the financial system had to be identified and monitored.

From a theoretical point of view, it has been shown that financial inclusion can lead to increased efficiency of financial intermediation (e.g. through the intermediation of larger volumes of domestic savings, which leads to strengthening of healthy domestic savings and investment cycles, and hence to increased stability) (Prasad, 2010). However, empirical investigations have only reached mixed conclusions. Some authors have extolled the merits of greater financial inclusion over stability (Adasme et al., 2006; Morgan & Pontines, 2014; Wang & Luo, 2022), arguing that higher financial inclusion not only increases the customer pool of banks and thus diversifies their risk but also broadens bank deposit base and contributes to their stability. The negative association between financial inclusion and financial stability is also shown by some other authors who argue that efforts by financial institutions to expand their services to a larger number of borrowers may loosen lending standards (H. R. Khan, 2011), causing proliferation of non-performing loans which may seriously threaten the stability of the financial system. Whether financial inclusion would promote or hinder bank stability thus depends on the off-setting forces of the positive and negative impacts of financial inclusion.

The ever-growing interest in these two financial phenomena, namely, financial inclusion and financial stability, coupled with the relative scarcity of studies examining the above nexus, motivate us to conduct this study. We focus on the African continent, which represents an ideal sample for this study as indicators of financial inclusion are all lower in Africa compared to the global average. In fact, according to Global Findex Database, in 2017, 35% of the African population has a bank account against 61.5% in the world. Besides, 27.4% of the world's population has formal savings, while only 15.4% of Africans deposit funds in a financial institution. Finally, 6.7% of the African population has taken out a loan from a financial institution in the last 12 months, compared to 10.7% globally. It is clear that there is still some room for improved financial inclusion in Africa. In the same vein, African countries have always been directly and indirectly haunted by financial crises stemming from the inability of African financial systems to contain exogenous shocks (Naudé, 2009; Oduro, 2009). Our contribution to the literature is as follows:

First, we investigate whether financial inclusion is either beneficial or detrimental to financial stability. Our baseline results suggest that financial stability increases amid elevated level of financial inclusion, which is consistent with the hypothesis that financial inclusion consolidates the situation of the household and small trade, reduce vulnerability of financial institutions through stabilized savings, thus contributing to the stability of the financial system as a whole.

Our results are robust to the gradual addition of control variables, alternative measures of financial inclusion and financial stability and different econometric methodologies.

Second, different from other studies that focus on the mere impact of financial inclusion on financial stability (Shihadeh & Liu, 2019; Vo et al., 2021; etc.), we also examine how the nexus of "financial inclusion-financial stability" may vary in alternative contexts, i.e. whether the favorable effect of financial inclusion on financial stability may be conditional on the number of factors. We thus assess whether income inequality, political stability and financial openness may play any modifying role.

Third, as far as we can tell, our study is among the first ones which focus on the investigation of the impact that financial inclusion has on financial stability on the African continent. While many studies have considered one cross section or a larger number of countries from diverse geographic locations (Marcelin et al., 2022; Saha & Dutta, 2022a) we concentrate on Africa as African countries may be characterized by similar demographic trends, quality of governance and economic development, which could help mitigate possible issues that may arise from of omitted variables due to data limitations. The dataset we employ covers 54 African countries for the period 2000–2020. Notice that the literature examining this nexus is still relatively scarce and this research comes in handy to fulfill some gap in the literature, shedding some light on the nature of the above relationship in the African context.

2. Literature review

In comparison to prior studies that investigated the nexus financial stability-economic growth or financial inclusion-unemployment for instance, there is only a scarcity of research on the specific impact of financial inclusion on stability, especially in the context of Africa. This is due to the scarcity of the data on financial inclusion. However, data on financial inclusion for international comparison purposes has recently been enriched by the proliferation of surveys. The IMF's (International Monetary Fund) Financial Access Survey (FAS), which covers 184 countries as of 2004, is the source of indicators of access to basic financial services. The Global Financial Index (Findex) and the Global Financial Development Database (GFDD) are also other potential sources of data which therefore provide detailed information on the access to financial services and their utilization. Besides, the ambiguity in the results reached by those studies motivates us to reconsider the association of this pair, especially in the context of Africa where studies that explore the above nexus are even rarer.

There has been some research on the economic outcomes of financial inclusion but largely on economic growth, inequality or poverty alleviation and more rarely on financial stability. For instance, Van et al. (2019) utilize panel data techniques on a heterogeneous sample of 36 developing countries to investigate the linkage financial inclusion-economic growth. Their study revealed that financial inclusion is positively associated with economic growth with a stronger effect for countries belonging to the low-income group. Another study by Cull et al. (2014) examines the interaction between financial inclusion and unemployment and finds that greater financial inclusion promotes job creation. Khan et al. (2021) on their part show from their empirical investigation on 54 African countries for the period 2001–2019 that financial inclusion reduces poverty and income inequality in Africa.

Several authors have found results consistent with a positive association between financial inclusion and financial stability. For example, Nguyen and Du (2022), using a sample 102 banks in six ASEAN countries over the period 2009–2019, reach the conclusion that an inclusive financial sector promotes bank stability by increasing customer deposit funding and reducing non-performing loans. Morgan and Pontines (2014) using the share of lending to small- and medium-sized enterprises (SMEs) and the number of SME borrowers as proxies for financial inclusion find evidence that financial stability, measured by bank Z-scores and non-performing loans, improves as a larger number of SMEs get financed. The findings of Ahamed and Mallick (2019) also support

the view of a positive association between financial inclusion and financial stability. Using data on 2635 banks in 86 countries between 2004 and 2012, the authors suggest that the institutional quality of a country, along with the customer deposit funding share, conditions the positive effect of inclusion on stability. Hannig and Jansen (2010) argue that the financial industry becomes more resilient to economic shocks as more financially distressed individuals or firms in the population are covered. They added that financial institutions that serve low-income groups are in a better position to boost the local economy and deal with the economic crisis. H. R. Khan (2011) points out three channels through which financial inclusion can positively affect financial stability, namely, greater diversification of bank assets, an increased number of small savers and a better transmission of monetary policy. Cihak et al. (2016) find that the increased stability enhanced by financial inclusion is conditioned by the quality of supervision. In this sense, countries with proper supervision and regulation of the financial system may experience an improved stability resulting from an increased financial inclusion, while the lack of supervision only leads to a more vulnerable financial system as more individuals or entities are covered, probably due to a drop in lending standards. A study by Pham and Doan (2020) looked into the relationship between financial inclusion and financial stability. Taking advantage of the Global Financial Inclusion Database, they show, using the Z-score of banks as a proxy for financial stability and usage of financial services and access to the financial system to measure financial inclusion that financial inclusion exerts only a weak positive influence on stability.

Some other studies, however, have also highlighted the negative impact that an increased coverage of the marginalized entities into the financial system can have on its stability. This may be the case when banks try to attract customers with poor credit line (Igan & Pinheiro, 2011), thus increasing the share of non-performing loans which may cause a distress in the financial industry. Additionally, an increased level of financial inclusion may raise transactional costs, while the risks associated with the establishment of financial institutions in new areas could lead to financial instability. In the same vein, the findings of Ozili (2021) revealed that, in developed countries, advanced nations and transition economies, the financial sector becomes riskier with increased account ownership due to a proliferation of non-performing loans and a high-cost inefficiency. Another study of this kind that has pointed to a negative interaction between financial inclusion and financial stability is a cross-country analysis by Sahay et al. (2015), who argue that this negative impact of financial inclusion may be related to a decline in bank buffers in countries experiencing non-compliance of the Basel principles of effective banking supervision.[1]

While the positive or negative impact of financial inclusion on financial stability is a clear cut in some studies, Ardic et al. (2013) show that data of bank stability from both the Financial Access Survey and Global Financial Development Database fail to establish a positive or negative association between financial stability and financial inclusion, which is measured in their study as deposit account penetration. They argue that this might be closely related to the inadequacy of solid data, while a non-straightforward relationship between the two is also suspected as a plausible reason. Some studies have also considered the nonlinearity of the relationship between financial inclusion and financial stability. For example, Saha and Dutta (2022a) use 3SLS and two-step GMM techniques to investigate the impact of financial inclusion on financial stability while considering a quadratic term for financial inclusion. Their result shows that financial inclusion helps stabilize the financial system at its lower level; however, this synergy turns into a trade-off as inclusion improves. They also find that governance positively moderates the impact of financial inclusion on stability.

Concerning related research pertaining to Africa, some studies have investigated the determinants of financial inclusion in Africa (Akudugu, 2013; Olaniyi, 2016; Zins & Weill, 2016 among others). Some others have focused on the impact of financial inclusion on different aspects of the economic activity. For example, Makina and Walle (2019) examined the impact of financial inclusion on growth from a panel of selected African countries and find a positive relationship between the pair. Nnyanzi et al. (2018) employ GMM techniques on a sample spanning from 1990 to 2014 to

show that financial inclusion is positively associated with tax revenue in eastern African countries. Ogunniyi et al. (2023) sought to empirically validate the presence or absence of a significant long-run relationship between sustainable economic growth and inclusion. Through an analysis of data from various sources spanning the years 2004 to 2022, their research confirms that the proximity to bank branches and access to credit by the private sector are crucial elements for attaining sustainable economic growth in both Nigeria and South Africa, while automated teller machine does not significantly contribute to sustainable economic growth in these countries. However, there are only a limited number of research on the nexus of financial inclusion and financial stability in Africa with the existing ones centering on one country, one subgroup of countries or a specific income group, etc. (Aduda & Kalunda, 2012; Amatus & Alireza, 2015; Jungo et al., 2022b; Leigh & Mansoor, 2016; Arora, 2019).

While different studies reach only mixed conclusions, the works centering on Africa are still relatively scarce as the lack of data constitutes a real handicap in the exploration of the financial inclusion-financial stability nexus. This study may provide additional evidence on the nature of this relationship which is of great importance for the social planner.

3. Data and variables
Table 1 summarizes the main variables we use in our study. It provides information on the description of the variables, their data source and some summary statistics including the mean, median and standard deviation. Our two variables of interest, namely financial inclusion and financial stability, come from the same source. Our sample comprises unbalanced panel data from 54 African countries with annual observations, as provided by the Global Financial Development Database, and covers the last two decades.

3.1. Financial inclusion
Definitions of financial inclusion often revolve around a concept of broader access to financial services at a reasonable cost. Notice that having access to financial services is mostly conditioned by owning an account in a so-called financial institution (Demirgüç-Kunt et al., 2015). As owning an account can also serve as a springboard to other financial services, the World Bank Group, through its initiative for universal access to financial services, has been working to ensure that every adult, everywhere in the world, has access to it, by 2020. We thus use the variable "Account at a formal financial institution" denoted by "ACCOUNT" as a proxy for financial inclusion. It is provided by the Global Findex database. Figures from our data show that during the period of study, the majority of African countries (85% of them) had an inclusion rate (the percentage of individuals older than 15 and owning an account at a formal financial institution) of less than 50%, while half of African countries had a financial inclusion rate of less than 20%. Mauritius is the country that exhibits the highest level of financial inclusion on average (82%) followed by Libya and Namibia at the second and third place, respectively (65% and 58%). In contrast, Sudan and the Democratic Republic of Congo have the lowest level of financial inclusion in Africa (6.9%). Over the years, the average level of account penetration in Africa experienced an increase from 26% in 2001 to 38% in 2020.

Other measures of financial inclusion that we employ as alternative proxies for financial inclusion are the percentage of adults older than 15 having contracted a loan from a formal financial institution and those having saved at a financial institution, denoted, respectively, by "LOAN" and "SAVED". On average, only 5.48% of Africans reported having taken a formal loan from a financial institution during the period of study. This figure is close to the one found by Demirgüç-Kunt and Klapper (2012) who show that 5% of adults in sub-Saharan Africa took a loan from a financial institution. The percentage of adults having saved at a financial institution (10.83%) is on average twice that of those who have taken out loans. Mauritius not only has the highest account penetration but also the highest percentage of adults using their account at formal financial institution to take loans (14%) that may probably serve financing of education and businesses. Additionally, around 30% of adults in Mauritius declared having saved at a financial institution,

Table 1. Variable definition and descriptive statistics						
Variables	**Description**	**Data source**	**Mean**	**Median**	**Std. dev.**	**N**
Bank Z-score (Z-SCORE)	Natural logarithmic of bank z-scores. It captures the risk of default or the financial stability of the commercial banking system	Global Financial Development Database and authors' own calculation	2.724	2.760	0.462	784
Account at a formal financial institution (ACCOUNT)	The percentage of individuals older than 15 and owning an account at a formal financial institution (bank, credit union, etc.)	Global Findex Database	24.520	20.445	17.710	987
GDP per capita(GDPPERK)	Gross domestic product divided by midyear population(thousands $)	World Development Indicators	2.491	1.150	3.236	942
GDP growth (BUSCYCLE)	Real GDP growth rate	World Development Indicators	−0.151	0.117	6.032	1006
Inflation(INFLATION)	Measured by the consumer price index, it reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services (%)	World Development Indicators	6.643	4.948	7.048	872
Real interest rate (RIR)	The lending rate adjusted for inflation as measured by the GDP deflator (%)	World Development Indicators	7.083	6.350	12.349	713
Broad money as share of GDP (BROADMON)	Ratio of broad money (M2) to GDP (%)	World Development Indicators	7.128	2.310	3.565	873

(Continued)

Table 1. (Continued)

Variables	Description	Data source	Mean	Median	Std. dev.	N
Financial crisis (CRISDUM)	A binary variable equal to 1 for the years 2007 and 2008 and 0 otherwise	Authors' own calculation	0.095	0	0.294	1134
Bank concentration (BKCONC)	Assets of five largest banks as a share of total commercial banking assets	Global Financial Development Database	75.276	76.247	18.133	790
Financial freedom(FINFREE)	Measure of the extent of government regulation of financial services and its influence on the allocation of credit ranged [0.100]	Heritage Foundation	42	40	14.525	908
Rule of law(RULEOFLAW)	Captures perceptions of the extent to which agents have confidence in and abide by the rules of society	Kaufmann et al. (2010)	−0.646	−0.690	0.594	952

This table presents the description and source of the main variables. We also report basic summary statistics including the mean, standard deviation and number of observations of the variables. The panel covers 38 African countries for the period 2001–2017.

making it the head in terms of savings on the continent. Libya and Namibia only exhibit figures close to average for our measure of financial inclusion related to loans taken, while Namibia (28.9%) comes second right after Mauritius when measuring the percentage of adults having saved. Similar to our first measure of financial inclusion, Sudan and the Democratic Republic of the Congo are among the countries where adults make the least loans (2.8 and 2.06%, respectively).

3.2. Bank stability

A stable financial system is one whose various components perform well and are able to withstand possible shocks. Following extant literature, we measure the stability of the financial system by using the z-score (Cihak & Hesse, 2010; Wu et al., 2020). The z-score is a widely used measure for assessing the financial health of banking institutions. The attractiveness of this index lies on its close link with the likelihood of bank insolvency, i.e. the likelihood that the value of their assets will be insufficient to cover the repayment of the liabilities incurred. The bank z-score thus captures the riskiness of banks and is computed as follows:

$$z - score_{it} = \frac{ROA_{it} + EA_{it}}{\sigma(ROA)_{it}}$$

where *ROA*, *EA* and *σ (ROA)* denote country-level aggregate figures of the return on assets, the ratio of equity over total assets and the standard deviation of return on assets, respectively. Higher (lower) z-score indicates a lower (higher) probability of default by financial institutions.

The bank z-score, directly available from the GFDD, is widely dispersed across our sampled African countries and, since it is highly skewed, we apply the natural logarithm to the z-score plus 1 (i.e. ln (1+z-score)). This proxy, denoted as *Z-SCORE* and ranging between 1.140 and 4.054, will be utilized as our measure of financial stability. In Africa, on average, most Maghreb countries, namely, Algeria, Egypt, Tunisia, Libya and Morocco, exhibit the highest z-scores (2.753, 3.038, 3.206, 3.445 and 3.658 and), i.e. the probability for their banking system to default is the lowest. Countries such as Mozambique (1.742) together with Sierra Leone (1.823) and Zimbabwe (1.839) show the weakest resilience of their banking industry. From 2000 to 2020, bank stability presented a saw tooth evolution trend on average, declining from 2001 to 2009, then experienced a sharp increase from 2009 to 2011, declining again till 2015 before bouncing back since then.

3.3. Control variables

To better capture the impact of financial inclusion on financial stability, we control in our baseline specification for a number of factors whose effects may be falsely attributed to those of financial inclusion. More precisely, we control for GDP per capita in thousands of US dollars and the H-P filtered GDP growth rate. While an increase in GDP per capita is desirable as it reflects the good health of the economy, whether this may be beneficial to banking sector stability is still questionable. Morgan and Pontines (2014) argue that richer countries are less vulnerable to financial shocks. We expect it to be negatively associated with financial stability. The H-P filter growth rate on its side provides information on the business cycles. Both expansion and recession could positively or adversely impact financial stability depending on which category of entities credit goes to. Inflation measured as the consumer price index is also included as a potential determinant of financial stability. We get rid of its outliers above the 99th percentile and below the 1st percentile of the sample distribution to rule out abnormality or probable measurement errors since some countries such as Zimbabwe may exhibit extremely high levels of inflation. We expect inflation to be detrimental to stability as the perception of future returns may be influenced by unstable prices making investors to restrict credit (Amatus & Alireza, 2015).

Table 2. Correlation of the variables

VARIABLES	Z-SCORE	ACCOUNT	GDPPERK	BUSCYCLE	INFLATION	RIR	BROADMON	CRISDUM	BKCONC	FINFREE	RULEOFLAW
Z-SCORE	1.000										
ACCOUNT	0.183***	1.000									
GDPPERK	0.259***	0.671***	1.000								
BUSCYCLE	−0.046	−0.010	0.012	1.000							
INFLATION	−0.107***	0.011	−0.136***	−0.068**	1.000						
RIR	0.046	−0.115***	−0.161***	0.025	−0.107***	1.000					
BROADMON	0.000	−0.089**	−0.050	−0.024	0.049	−0.274***	1.000				
CRISDUM	−0.023	−0.054*	0.011	0.029	0.124***	−0.058	−0.021	1.000			
BKCONC	0.028	−0.092**	0.102***	−0.040	0.002	−0.010	0.004	0.010	1.000		
FINFREE	0.064*	0.194***	0.056*	0.001	0.037	0.122***	−0.095**	0.077**	−0.096**	1.000	
RULEOFLAW	0.155***	0.423***	0.181***	0.027	−0.072**	−0.007	0.002	0.005	0.041	0.408***	1.000

This table presents the coefficients of the pairwise correlation between the variables described in Table 3.1. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

We control for real interest rate as well. Low interest rates facilitate access to credit for small and medium enterprises. In the same vein, higher interest rates compromise the ability of SMEs to repay, thus putting the financial system at a risk. Following King and Levine (1993), we also control for broad money as a share of GDP. Siddik and Kabiraj (2018) show that a rising money supply tends to reduce stability in the financial system.

As our study covers the period 2000–2020, we also include a dummy variable that controls for the subprime crisis. We construct a dummy equal to 1 for the years 2007 and 2008 and 0 otherwise. This variable is expected to be negatively correlated with financial stability (Noman et al., 2017).

We control for bank concentration as well. Its impact on financial stability has never been a clear cut in extant literature. Ali et al. (2018), for example, find evidence that concentration does not directly affect stability; it only does indirectly thorough the profitability (positively) and the interest rate (negatively) channels. Our study may provide additional evidence on the nature of this relationship. Note that a greater financial freedom is also suspected to be beneficial to financial stability as foreign bank entry may help improve the soundness of the local banking system via the advanced technologies and enriching experience they bring in (Wu et al., 2017). As a sound legal framework is capital to promote financial stability as it encourages transparency in the financial sector, we exploit Kaufmann et al. (2010)'s governance indicators' rule of law to capture this aspect.

We present the pairwise correlation coefficients in Table 2. The coefficients exhibit no serious multicollinearity problems, suggesting that our variables can be jointly included in our model specification. Additionally, bank Z-SCORE is significantly and positively correlated with our indicator of financial inclusion, providing us with some suspicion about the nature of the relationship between these two variables.

4. Model and methodology

The conceptual framework that illustrates the interaction between financial inclusion and financial stability and motivates our empirical formalization is based on Cihak et al. (2016). If it is true that financial policymakers attach particular importance to financial inclusion and financial stability as they represent the expected outcomes of their policies, they could, however, miss important aspects by ignoring their interaction.

Based on previous empirical investigations and variable selection (Boachie et al., 2021; Wang & Luo, 2022, among others), we develop our baseline model which takes the form:

$$Z - SCORE_{it} = \beta_0 + \beta_1 ACCOUNT_{it} + \beta_2 X_{it} + . + v_i + u_t + \in_{it}$$

Where i and t capture the time and country characteristics, respectively. Z-SCORE is the dependent variable which measures the stability of the banking industry. ACCOUNT stands for financial inclusion. It is measured in our study using the number of accounts at financial institutions.[2] X is the set of control variables provided by extant literature regarding the determinants of financial stability. Country and year fixed effects are denoted by v_i and u_t respectively while ϵ_{it} represents the idiosyncratic error term. β_1 is the coefficient of interest to be estimated, which measures the ceteris paribus impact of financial inclusion on bank stability. β_2 represents the set of parameters associated with our control variables.

As the results of the Hausmann tests support the fixed effects model, we initially employ the fixed-effects (FE) estimator to assess the impact of financial inclusion on financial stability since there lacks homogeneity in the country sample.[3] It is an econometric methodology which controls for time-invariant omitted variables. However, we also present results from the random-effects

(RE) estimator as the inclusion of fixed effects means that the estimation of variables with little within-country time variation may suffer from a lack of precision. Our estimations use robust standard errors which allow for heteroscedasticity and serial correlation. Robustness checks including the use of alternative econometric methodologies, dependent or independent variables and the dealing with endogeneity issues will also be considered in later sections.

5. Baseline results

Our baseline results are presented in Table 3. Notice that our measure of financial inclusion is always significant when the variables are added gradually in our model. For the purpose of brevity, we show results when only the index of financial inclusion is added along with the year dummies (column 1), followed by results when we introduce variables that gauge the overall state of the economy (column 2) and finally when all the other variables (column 3) controlled for are added.

With the bank Z-SCORE as the dependent variable, our results point to a positive and significant association between financial inclusion measured in our study by the number of accounts at a financial institution and financial stability at the 5% significance level. These results suggest that in Africa, as the number of individuals owning a bank account at a formal financial institution increases, the probability of default of those institutions becomes smaller. An increased financial inclusion reflected by a broader access to financial services is thus beneficial to the stability of the financial system as a whole. The results are consistent with the findings of H. R. Khan (2011) and Hannig and Jansen (2010), who show that financial inclusion (higher account penetration) tends to reduce the riskiness of domestic banks as it facilitates other financial services and the effectiveness of the system. Indeed, our findings are in line with the hypothesis that an improvement in the number of small savers stabilizes savings, reduces dependency by banks on hazardous financing, thus making them more resilient to exogenous shocks. Using Table 3' columns 3 as an example, we note that the coefficients of ACCOUNT are very similar (0.010 for FE and 0.012 for RE) suggesting that even with the assumption that for the random-effects estimation, the time-invariant fixed effect is assumed independent of the covariates as opposed to fixed effects estimations where the time-invariant fixed effect is assumed related with the covariates, the estimates are not too much affected. Taking the results from the fixed-effects estimator as a benchmark, this suggests that a 1% increase in the number of accounts at financial institutions may increase the overall financial stability by 0.010 (1.2%). In other words, an increase of one standard deviation in financial inclusion (18.27%) is associated with an increase of (18.050 × 0.010/ 0.462) = 0.391 standard deviation in financial stability.

Of the control variables, GDPPERK is negative and significant at the 1% level which indicates that richer countries may suffer more from financial instability. These results which seem counterintuitive contradict the findings of Morgan and Pontines (2014) who suggest that richer countries are less likely to experience financial instability. The nature of this relationship thus deserves more attention in further research. GDP growth (BUSCYCLE), however, exerts a positive impact on financial stability as expected (Van et al., 2019). A booming economy is thus favorable to financial stability. Though not significant, some other conditioning variables such as CRISDUM and RULEOFLAW have the expected signs, that is, the subprime crisis of 2007–2008 has had a stability-reducing impact in African economies, while a society where citizens abide by the law and where law enforcement is a reality is favorable to financial stability via transparency.

6. Robustness checks

To check the consistency of our baseline results, we conduct a series of robustness tests.

6.1. Alternative measures of financial inclusion

First, we employ two alternative measures of financial inclusion. Besides studying the impact of an increased number of accounts at financial institutions, we now assess whether an increased number of loans and savings by adults older than 15 at financial institutions may enhance the stability of the financial industry. Indeed, accessing a current account is only a first step towards

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Table 3. The impact of financial inclusion on financial stability						
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Dependent Variable: Z-SCORE	**Fixed Effects**	**Fixed Effects**	**Fixed Effects**	**Random Effects**	**Random Effects**	**Random Effects**
ACCOUNT	0.001	0.009***	0.010***	0.002	0.012***	0.012***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
GDPPERK		−0.079***	−0.088***		−0.052**	−0.054**
		(0.023)	(0.022)		(0.024)	(0.027)
BUSCYCLE		0.002*	0.002**		0.001	0.001
		(0.001)	(0.001)		(0.001)	(0.001)
INFLATION		0.004	0.005*		0.004*	0.005**
		(0.002)	(0.003)		(0.002)	(0.003)
RIR		0.002	0.002		0.002	0.002
		(0.002)	(0.002)		(0.002)	(0.002)
BROADMON		0.005	0.004		0.005	0.004
		(0.004)	(0.005)		(0.006)	(0.007)
CRISDUM		0.057	0.046		0.034	0.019
		(0.068)	(0.074)		(0.066)	(0.069)
BKCONC			−0.002			−0.001
			(0.001)			(0.001)
FINFREE			0.002			0.001
			(0.002)			(0.002)
RULEOFLAW			0.088			0.088
			(0.086)			(0.088)
CONSTANT	2.679***	2.471***	2.577***	2.641***	2.300***	2.380***
	(0.102)	(0.139)	(0.177)	(0.102)	(0.156)	(0.203)
Year dummies	YES	YES	YES	YES	YES	YES
R^2	0.057	0.321	0.360	0.095	0.334	0.360
Observations	754	365	337	754	365	337
Number of countries	43	24	24	43	24	24

This table reports the estimated coefficients derived from the baseline specification. The dependent variable used as a proxy for financial stability is the natural logarithmic of the «bank Z-score +1» (Z-SCORE) which captures the probability of default of banks. We measure financial inclusion by using the percentage of people having an account at a formal financial institution (ACCOUNT). GDP per capita (GDPPRK) is the gross domestic product divided by the midyear population. BUSCYCLE is the Hodrick-Prescott filtered real GDP growth rate. Inflation (INFLATION) is measured by the percentage change in the consumer price index (CPI). The lending rate adjusted for inflation is used to proxy for the real interest rate (RIR), while Bank concentration (BKCONC) measures the market structure represented by the assets of the five largest banks as a share of total assets. Financial freedom (FINFREE) is the measure of financial liberalization, largely the independence of financial institutions from government control and intervention, while the ratio of broad money to GDP (BROADMON) is used to proxy for money supply. CRISIS is a dummy (equal to zero for the years 2007–2008 and 0 otherwise) that captures the effect of the subprime crisis. Finally, RULEOFLAW is defined as the extent to which agents abide by the rules of the society. All regressions are estimated by using fixed effects estimator for panel data with country and year fixed effects. We also show results from a random effects estimation. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

full financial inclusion, paving the way for saving money, taking out loans, as well as sending and receiving payments. We investigate whether the opening of bank accounts by the newly-included individuals is not just "window dressing" but an opportunity for them to contract loans from these institutions and make savings. Our new measures of financial inclusion (loan from financial institutions, denoted by" LOAN" and saved at a financial institution denoted by "SAVED") just as

the first one is obtained from the GFDD, and the results of our estimations are presented in Table 4. Our findings are similar to our baseline results and suggest that an increased number of loans from financial institutions to the people primarily having a hard time to access financial services tends to stabilize the financial sector. Increased savings is likewise beneficial to financial stability as SAVED carries a positive and significant coefficient. While many views warn of an elevated riskiness due to a decline in lending standards or poor supervision (Mehrotra & Yetman, 2015; Morgan & Pontines, 2018), our results fall in line with those of Hannig and Jansen (2010) who argue that during financial crises, low-income savers and borrowers keep their financial behavior, keeping deposits in a safe place and paying off their loans. Following Jungo et al. (2022a) and Feghali et al. (2021) who argue that using individual measures of financial inclusion may produce biased results, we also experiment using the principal component analysis (PCA) techniques to combine the several dimensions of financial inclusion considered in this study and related to account ownership, access to bank credit and money saving. We use this new proxy for denoted «FI» as our new indicator of financial inclusion and reconduct our regressions.[4] We present the results in the last three columns of Table 4. We still find statistical evidence, similar to our baseline results, that financial inclusion is indeed effective to promote financial stability in African countries. Concerning other control variables, GDPPERK is negatively and statistically related to financial stability as in our baseline results while FINFREE exhibits a positive sign, meaning that financial liberalization may help reduce riskiness of banks. In fact, with cross-border capital mobility, risk sharing opportunities may increase allowing domestic investors to diversify their risks. Also, a foreign bank penetration following liberalization may push for an amelioration of the regulatory financial framework, thus increasing overall financial stability.

6.2. Alternative measures of financial stability

Second, we adopt different proxies for financial stability. We replace bank z-scores by the non-performing loans to total loans (NPL) and bank capital to total assets (CAR) ratios and use these new indicators of financial soundness as our new dependent variable, respectively. Non-performing loans are identified as such when the default on payments has lasted for 90 days. The passage of time increases the probability of default by the borrower, and the bank must suffer the consequences. Regarding the capital-to-assets ratio, it is a measure of a bank's available capital expressed as a percentage of a bank's risk-weighted credit exposures. Essential to ensure that banks have a sufficient cushion to absorb a reasonable amount of losses before they become insolvent, it is also used by regulators to determine the capital adequacy of banks and to perform stress tests. If it is positive, the higher it will be, the more the bank will be considered to be in good financial health. We thus investigate whether a better financial coverage in terms of account penetration is likely to increase financial stability via a reduced level of non-performing loans or an improved bank's performance. We find that the estimated coefficient on ACCOUNT is negative and statistically significant at 1% level when NPL is utilized as our measure of stability and positive when CAR becomes our response variable (Table 5). The results we get suggest that a broader usage of bank accounts helps reduce the amount of non-performing loans, thus improves bank's performance. In line with our baseline results, GDPPERK again exhibits a positive association with financial stability. INFLATION is found to exacerbate the risk-taking of banks as expected, consistent with the findings of Cubillas and González (2014) and Wu et al., (2017). Inflation can make the loan agreement an easy task by reducing the real value of outstanding loans, but on the other hand, it can also reduce the real income of borrowers when wages are rigid.

6.3. An alternative econometric methodology

Third, we consider a more robust econometric methodology. To assess the impact on stability of financial inclusion, we also apply the Generalized Methods of Moments (GMM) estimator. **GMM** generalizes the method of moments by allowing the number of moment conditions to be greater than the number of parameters. These moment conditions are functions of the model parameters and the data, such that their expectation is zero at the parameters' true values. Choosing this methodology is motivated by the following reasons: First of all, this method is consistent with the panel structure of our data as cross-country variations are not eliminated. Second, GMM requires to

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Table 4. Robustness check: alternative measures of financial inclusion

Dependent variable: Z-SCORE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
LOAN	0.010	0.014**	0.015*						
	(0.009)	(0.006)	(0.007)						
SAVED				0.009	0.015*	0.014*			
				(0.007)	(0.008)	(0.008)			
FI							0.036	0.051**	0.055**
							(0.027)	(0.020)	(0.023)
GDPPERK		−0.064***	−0.072***		−0.035**	−0.017		−0.042**	−0.046***
		(0.021)	(0.018)		(0.013)	(0.020)		(0.017)	(0.015)
BUSCYCLE		0.001	0.001*		0.001	−0.000		0.001	0.001
		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)
INFLATION		0.004	0.005		0.004	0.004		0.003	0.004
		(0.002)	(0.003)		(0.002)	(0.003)		(0.003)	(0.003)
RIR		0.001	0.002		0.002	0.003		0.002	0.002
		(0.002)	(0.002)		(0.001)	(0.002)		(0.002)	(0.002)
BROADMON		0.004	0.003		0.007*	0.008		0.005	0.004
		(0.004)	(0.005)		(0.004)	(0.005)		(0.004)	(0.005)
CRISDUM		0.050	0.041		−0.076*	−0.059		−0.078	−0.096
		(0.069)	(0.073)		(0.039)	(0.038)		(0.054)	(0.057)
BKCONC			−0.001			−0.001			−0.001
			(0.001)			(0.002)			(0.002)
FINFREE			0.002			−0.000			0.002
			(0.001)			(0.002)			(0.002)

(Continued)

Table 4. (Continued)

Dependent variable: Z-SCORE	(1) Fixed Effects	(2) Fixed Effects	(3) Fixed Effects	(4) Fixed Effects	(5) Fixed Effects	(6) Fixed Effects	(7) Fixed Effects	(8) Fixed Effects	(9) Fixed Effects
RULEOFLAW			0.097			0.045			0.083
			(0.089)			(0.123)			(0.100)
CONSTANT	2.649***	2.630***	2.701***	2.623***	2.569***	2.636***	2.752***	2.769***	2.855***
	(0.0661)	(0.130)	(0.165)	(0.0846)	(0.147)	(0.224)	(0.0218)	(0.0954)	(0.162)
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.062	0.295	0.338	0.038	0.235	0.182	0.057	0.256	0.288
Observations	754	365	337	754	365	337	754	365	337
Number of countries	43	24	24	43	24	24	43	24	24

This table reports the results of the impact of financial inclusion on financial stability, when using alternative measures of financial inclusion namely the percentage of individuals older than 15, having borrowed money from a financial institution (LOAN) and the percentage of individuals older than 15, having saved money in their account (SAVED) and a composite index of financial inclusion denoted «FI» obtained from Principal Component Analysis (PCA). We still add covariates gradually as in our baseline results. All regressions are estimated by using fixed effects estimator for panel data with country and year fixed effects. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 5. Robustness check: An alternative measure of financial stability						
	NPL (1)	NPL (2)	NPL (3)	CAR (1)	CAR (2)	CAR(3)
VARIABLES	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
ACCOUNT	0.0225	−0.170	−0.205**	0.007*	0.009*	0.010**
	(0.098)	(0.117)	(0.097)	(0.004)	(0.005)	(0.004)
GDPPERK		2.895*	0.727		0.020	0.086
		(1.618)	(1.019)		(0.077)	(0.082)
BUSCYCLE		−0.278**	0.164		0.002	−0.013
		(0.119)	(0.129)		(0.007)	(0.011)
INFLATION		0.052	0.031		−0.001	−0.003
		(0.090)	(0.112)		(0.010)	(0.010)
RIR		−0.00869	0.00132		0.001	0.001
		(0.0849)	(0.105)		(0.004)	(0.004)
BROADMON		−0.548	−0.500		0.014	0.009
		(0.364)	(0.358)		(0.012)	(0.013)
CRISDUM		−0.930	−0.774		0.018	0.005
		(2.117)	(2.058)		(0.220)	(0.221)
BKCONC			0.147**			−0.007**
			(0.0529)			(0.003)
FINFREE			−0.0312			0.005
			(0.0865)			(0.003)
RULEOFLAW			−10.61***			0.309**
			(3.303)			(0.108)
CONSTANT	9.189***	7.864	2.612	2.111***	1.889***	2.068***
	(3.257)	(6.333)	(7.271)	(0.138)	(0.208)	(0.295)
Year dummies	YES	YES	YES	YES	YES	YES
R-squared	0.134	0.258	0.441	0.063	0.077	0.212
Observations	420	219	201	405	219	202
Number of countries	32	18	17	32	19	17

This table reports the results of the impact of financial inclusion on financial stability, when using two alternative measures of financial stability or soundness namely the ratio of non-performing loans to total loans (NPL) and the capital to assets ratio (CAR). We control for the full set of covariates included in the baseline model. All regressions are estimated by using fixed effects estimator for panel data with country and year fixed effects. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

have a greater number of cross-sections (N) as compared to the time period (T), a condition which is met in our case as we have $N = 54$ and $T = 21$. Finally, this method makes it possible to control for both the specific individual and temporal effects and to level out the endogenous biases of the variables, especially when there is one or more lags of the dependent variable appearing as explanatory variable. It also restricts over-identification and controls for cross-sectional dependence (Tchamyou, 2018). Developed by Arellano and Bond (1991), then generalized by Arellano and Bover (1995), the dynamic panel GMM method provides solutions to the problems of simultaneity bias, reverse causality and omitted variables. We add one year lagged dependent variable as a new regressor to the benchmark model specification to make it a dynamic one. The revised model takes the following form:

$$Z - SCORE_{it} = \beta_0 + \alpha_1 Z - SCORE_{it-1} + \beta_1 ACCOUNT_{it} + \beta_2 X_{it} + . + \in_{it}$$

Table 6. Robustness check: an alternative econometric methodology			
Dependent variable:	(1)	(2)	(3)
Z-SCORE	GMM	GMM	GMM
L. Z-SCORE	0.766***	0.735***	0.703***
	(0.254)	(0.117)	(0.121)
ACCOUNT	0.002	0.005***	0.005***
	(0.003)	(0.002)	(0.002)
GDPPERK		−0.009	−0.020
		(0.013)	(0.012)
BUSCYCLE		−0.001*	−0.001
		(0.001)	(0.001)
INFLATION		0.002	0.002
		(0.001)	(0.001)
RIR		0.001	0.002
		(0.001)	(0.001)
BROADMON		−0.002	−0.001
		(0.003)	(0.004)
BKCONC			−0.002
			(0.002)
FINFREE			0.002**
			(0.001)
RULEOFLAW			0.042
AR(1) p-value	0.016	0.007	0.011
AR(1) p-value	0.248	0.655	0.697
Hansen OID p-value	0.235	0.218	1.000
Observations	410	240	236
Number of countries	36	21	20

This table reports the results of the impact of financial inclusion on financial stability, when using an alternative econometric methodology: the Generalized Method of Moments (GMM) after having included one year lag of the dependent variable as a new regressor (Z-SCORE) to transform the model into a dynamic one. We control for the full set of covariates included in the baseline model. All regressions are estimated by the first difference GMM estimator. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

where Z-SCORE$_{t-1}$ is the newly added lagged dependent variable and α_1, the coefficient measuring its effect. All the other elements are identical to that of our baseline specification.

We adopt a first-difference GMM estimator. It assumes homoscedastic error variances across countries and time and independence of error terms. The effectiveness of the GMM estimator relies on the validity of the following assumptions: (i) the instruments are valid and (ii) the error terms are not auto-correlated. To test the validity of instruments, Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) suggested the Hansen/Sargan over-identification tests. In this work, we use the Hansen test because it is effective in the presence of autocorrelation and heteroscedasticity problem. We also perform a second-order autocorrelation test to verify the hypothesis of non-error terms.

The results derived from the estimation of the model and presented in Table 6 reveal that our indicator of financial inclusion is positively associated with Bank Z-SCORE, our proxy for financial stability, providing additional evidence on the positive relationship between financial inclusion and bank stability. The lagged ZSCORE also carries a positive and significant coefficient at the 5% level, implying that the current level of financial stability depends on its previous year level. Table 6 also

exhibits the results from our diagnosis tests. Both the AR (2) and the Hansen over-identification tests fail to reject the null hypothesis, suggesting no misspecification problems and validity of our instruments, respectively.

6.4. An additional control

To avoid an overstated estimate on the impact of financial inclusion on financial stability, we next introduce "macroprudential policy" as an additional control as financial stability may be also conditional on the effectiveness of financial regulations. The ultimate objective of macroprudential policies is to preserve financial stability. This includes increasing the resilience of the financial system and limiting the build-up of vulnerabilities, in order to mitigate systemic risk and ensure that financial services continue to be delivered efficiently (Bennani et al., 2014). We employ a new measure of macro-prudential policy provided by the integrated Macro-prudential Policy (iMapp) by Alam et al., (2019). We consider this new measure as it provides a comprehensive picture of macro-prudential policy with a wider coverage of instruments, countries and time periods. The findings of this exercise reported in Table 7 which consists in increasing an additional control variable reveal that the coefficient on Z-SCORE not only remains statistically significant, but it actually rose slightly in magnitude (to 0.013) when all covariates are included in our estimation, suggesting that our baseline results that financial inclusion improves financial stability remain unaffected by the introduction of the proxy for macroprudential policy whose estimate is not statistically significant.

6.5. Ruling out countries from the CFA Franc zone

We finally consider ruling out countries from the CFA zone as a final robustness check. The Franc Zone is an economic and monetary zone made up of two monetary unions namely WAEMU and ECCAS, bringing together eight and six African countries, respectively, and then Comoros.[5] These countries are former French colonies that have in common the CFA Franc, a currency which has a fixed parity with the Euro (1 € = 655.957 CFA francs). Although its detractors call it the currency of voluntary servitude, reminiscent of the vestiges of colonization (Eyebiyi, 2017; Jacquemot, 2018), the member countries of the franc zone, which aims to promote monetary and financial stability and the development of trade within the said zone defend the usefulness of their common currency, which remains a factor of stability. Over the past two decades, the fixed exchange rate regime has been particularly effective in maintaining inflation rates which, in the WAEMU and ECCAS zones, have been close to their target of 3% and even slightly below. On the contrary, in the rest of sub-Saharan Africa, inflation rates approached double digits—which is macroeconomically disturbing. Aware of that, we experiment ruling out the African countries that belong to the CFA franc zone as they pretend to be more stable. Having ruled out the "CFA countries" from our observations, we rerun our regressions and present our results in Table 8. We find that our main findings are similar to our baseline results after having ruled out CFA countries, which implies that our baseline result is probably driven by "non CFA" countries, seemingly suggesting that financial inclusion is more effective in improving financial stability in those countries as the CFA currency may bring some financial stability within the franc zone even if it also undermines the export price competitiveness of member countries. We do not report the results of the "CFA countries" as regressions yield no significant results. In short, having excluded CFA countries, we still find statistical evidence that the resilience of the financial system is enhanced as financial services become available for financially distressed individuals.

7. Extended analysis

In this section, we investigate whether the nexus financial inclusion-financial stability may be conditional on a certain number of factors. To be specific, we examine whether country character-istics such as income inequality, political stability and financial openness could play any modifying role on the impact of financial inclusion on financial stability.

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Table 7. Robustness check: adding macroprudential policy as an additional control			
Dependent variable: Z-SCORE	(1)	(2)	(3)
	Fixed Effects	Fixed Effects	Fixed Effects
ACCOUNT	0.005	0.012***	0.013***
	(0.005)	(0.003)	(0.003)
MAPP	−0.026	−0.014	−0.016
	(0.020)	(0.016)	(0.017)
GDPPERK		−0.114***	−0.127***
		(0.032)	(0.029)
BUSCYCLE		0.005*	0.007*
		(0.003)	(0.003)
INFLATION		0.003	0.005
		(0.003)	(0.003)
RIR		0.001	0.001
		(0.002)	(0.003)
BROADMON		0.002	0.001
		(0.006)	(0.007)
CRISDUM			0.063
			(0.082)
BKCONC			−0.000
			(0.002)
FINFREE			0.001
			(0.001)
RULEOFLAW			0.002
			(0.118)
CONSTANT	2.547***	2.420***	2.374***
	(0.136)	(0.172)	(0.237)
Year dummies	YES	YES	YES
R-squared	0.072	0.335	0.361
Observations	423	222	202
Number of countries	27	15	15

This table reports the results when considering macroprudential policy (MAPP) as an additional covariate. We control for the full set of covariates included in the baseline model. All regressions are estimated by the first difference GMM estimator. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

7.1. The effect of different levels of inequality on the nexus financial inclusion-financial stability

First, we investigate whether the level of income inequality prevailing in different African nations may condition the impact of financial inclusion on financial stability. Income inequality is still a social concern in Africa. In fact, the overall level of inequality observed in Africa conceals large differences from region to region. The countries of the south and, to a lesser extent, those of Central Africa are particularly unequal. In other words, inequalities tend to decrease as the focus is shifted towards the west and north of the continent. Thus, the share of national income remunerating the richest 10% ranges from 37% in Algeria to 67% in Botswana, while the share remunerating the poorest 40% ranges from 14% in Algeria to 4% in South Africa (Chancel et al., 2019). While some scholars have reached the conclusion that banks generally tend to concentrate the loans they grant on high-income borrowers, a strand of literature (Neaime & Gaysset, 2018, among others) have also highlighted the fact that access to the financial system reduces income inequalities, stimulates job creation and reduces

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Table 8. Robustness check: ruling out CFA countries			
	(1)	**(2)**	**(3)**
VARIABLES	**Fixed Effects**	**Fixed Effects**	**Fixed Effects**
ACCOUNT	0.005*	0.009***	0.010***
	(0.003)	(0.003)	(0.003)
GDPPERK		−0.079***	−0.088***
		(0.023)	(0.022)
BUSCYCLE		0.002*	0.002**
		(0.001)	(0.001)
INFLATION		0.004	0.005*
		(0.002)	(0.003)
RIR		0.002	0.002
		(0.002)	(0.002)
BROADMON		0.005	0.004
		(0.004)	(0.005)
CRISDUM			0.046
			(0.074)
BKCONC			−0.002
			(0.001)
FINFREE			0.002
			(0.002)
RULEOFLAW			0.088
			(0.086)
CONTANT	2.585***	2.471***	2.577***
	(0.115)	(0.139)	(0.177)
Year dummies	YES	YES	YES
R-squared	0.128	0.321	0.360
Observations	573	365	337
Number of countries	33	24	24

This table reports our results when ruling out non CFA countries from our sample. We also control for all other variables included in the baseline model. All regressions are estimated by using fixed effects estimator for panel data with country and year fixed effects. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

people's vulnerability to unforeseen income losses. Unbanked people find it more difficult to save, plan, start a business or overcome the vagaries of life. To assess whether the level of income inequality measured by the Gini index may condition the impact of financial inclusion on stability, we group our sample according to the median value of the Gini index which in our sample is 41.7 and conduct fixed-effects regressions on each specific group. In fact, the Gini index is the most commonly used income inequality index. It evaluates the average difference between the incomes of two households (persons) chosen randomly. Its value ranges between 0 and 100 with 0 meaning that all households receive the same income (perfect equality) and 100 meaning that a single household receives the entire income (perfect inequality). Income inequality in our study is measured by the Gini index provided by Solt (2016) and compiled in the Standardized Income Inequality Database. The results are reported in Table 9.

Although consistently positive, the coefficient on ACCOUNT is statistically significant only for the sub-group of countries where income inequality is high, which implies that countries where the income gap between the rich and poor is most severe experience a more pronounced impact of

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Table 9. The effect of different levels of inequality on the nexus financial inclusion-financial stability						
		Panel (I)			**Panel (II)**	
VARIABLES	**High Inequality**	**High Inequality**	**High Inequality**	**Low Inequality**	**Low Inequality**	**Low Inequality**
ACCOUNT	0.005	0.006**	0.006**	0.008	0.056	0.050
	(0.003)	(0.002)	(0.003)	(0.010)	(0.028)	(0.042)
GDPPERK		−0.069***	−0.074***		−0.178	−0.204
		(0.016)	(0.014)		(0.114)	(0.188)
BUSCYCLE		0.001**	0.001*		0.008	0.008
		(0.000)	(0.000)		(0.005)	(0.004)
INFLATION		−0.001	−0.003		0.008	0.004
		(0.004)	(0.003)		(0.008)	(0.007)
RIR		0.003	0.003		0.000	0.000
		(0.002)	(0.002)		(0.003)	(0.004)
BKCONC		−0.000	−0.004		0.005	0.003
		(0.005)	(0.005)		(0.026)	(0.030)
FINFREE		0.075	−0.076		0.124	0.233
		(0.106)	(0.063)		(0.212)	(0.511)
BROADMON			−0.001			0.002
			(0.003)			(0.005)
CRISDUM			0.000			0.006**
			(0.003)			(0.002)
RULEOFLAW			0.0521			0.248
			(0.091)			(0.437)
CONSTANT	2.246***	2.310***	2.606***	2.497***	1.193	1.106
	(0.149)	(0.160)	(0.268)	(0.260)	(0.932)	(2.178)
Year dummies	YES	YES	YES	YES	YES	YES
R-squared	0.106	0.305	0.338	0.098	0.393	0.490
Observations	307	287	193	188	79	72
Number of countries	34	19	19	21	11	11

This table reports the impact of financial inclusion on financial stability in countries with different levels of inequality. In panel (I), we use only the sub-sample countries experiencing high levels of income inequality and use the sub-sample of countries with lower levels of inequality in Panel (II). The variables are still added progressively into the regressions. All regressions are estimated by using fixed effects estimator for panel data with country and year fixed effects. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

financial inclusion on financial stability. Countries characterized by such high levels of inequality have indeed failed to provide credit to the most disadvantaged segments of the population. The effects of a broader inclusion are likely to be detected more intensely in these countries, which will lead to a more sustained stability of the financial system, lending additional evidence on the impact of income inequality on the linkage financial inclusion-financial stability.

7.2. The effect of different levels of political stability on the nexus financial inclusion-financial stability

Next, we investigate whether the level of political stability prevailing in different African nations may condition the impact of financial inclusion on financial stability. Macroeconomic and political stability and the quality of governance are essential conditions to compensate for

		Panel (I)			Panel (II)	
VARIABLES	**High Stability**	**High Stability**	**High Stability**	**Low Stability**	**Low Stability**	**Low Stability**
ACCOUNT	0.000	0.010***	0.010***	0.002	0.006	0.004
	(0.004)	(0.003)	(0.003)	(0.006)	(0.006)	(0.004)
GDPPERK		−0.143***	−0.158***		−0.038	−0.047**
		(0.028)	(0.032)		(0.028)	(0.021)
BUSCYCLE		0.008***	0.008***		0.001	0.001
		(0.003)	(0.003)		(0.001)	(0.001)
INFLATION		−0.001	−0.003		0.011**	0.012**
		(0.001)	(0.002)		(0.004)	(0.004)
RIR		−0.001	−0.001		0.005***	0.005**
		(0.001)	(0.001)		(0.002)	(0.002)
BKCONC		0.008	0.002		0.006	0.005
		(0.009)	(0.009)		(0.006)	(0.007)
FINFREE		−0.053	−0.070		0.146	0.162
		(0.079)	(0.085)		(0.115)	(0.131)
BROADMON			−0.002			−0.004
			(0.002)			(0.003)
CRISDUM			0.003			0.004**
			(0.002)			(0.002)
RULEOFLAW			−0.036			−0.036
			(0.093)			(0.202)
CONSTANT	2.757***	2.784***	2.826***	2.601***	2.278***	2.428***
	(0.114)	(0.109)	(0.193)	(0.181)	(0.216)	(0.300)
Year dummies	YES	YES	YES	YES	YES	YES
R-squared	0.073	0.496	0.515	0.070	0.384	0.449
Observations	476	212	193	270	152	143
Number of countries	43	20	17	29	16	16

Table 10. The effect of political stability on the nexus financial inclusion-financial stability

This table reports the impact of financial inclusion on financial stability in countries with different levels of political stability. In panel (I), we use only the sub-sample countries experiencing high levels of political stability and use the sub-sample of countries with lower levels of political stability in Panel (II). The variables are still added progressively into the regressions. All regressions are estimated by using fixed effects estimator for panel data with country and year fixed effects. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

the strong preference of agents for fiduciary money, both for reasons for transaction than precaution. In a context characterized by an insufficiently favorable political climate (socio-political unrest, acts of terrorism, anti-government activities, etc.) the protection of investors' property rights and the ability to enforce contracts, in particular to mobilize guarantees associated with a credit, are weak, which discourages the search for new customers by the banks. To assess whether the level of political stability measured by Kaufmann et al. (2010)'s governance indicator referred to as «political stability» may condition the impact of financial inclusion on stability, we group our sample according to the median value of the political stability indicator and conduct fixed-effects regressions on each specific group. The results are reported in Table 10.

✱ **cogent** ⤳ economics & finance

Table 11. The effect of financial openness on the nexus financial inclusion-financial stability						
		Panel (I)			**Panel (II)**	
VARIABLES	**High financial openness**	**High financial openness**	**High financial openness**	**High financial openness**	**Low financial openness**	**Low financial openness**
ACCOUNT	−0.004	0.010***	0.010***	0.001	0.010**	0.005
	(0.005)	(0.003)	(0.00252)	(0.007)	(0.005)	(0.004)
GDPPERK		−0.138***	−0.143***		−0.002	−0.018
		(0.020)	(0.025)		(0.016)	(0.015)
BUSCYCLE		0.009**	0.011***		−0.000	0.000
		(0.003)	(0.003)		(0.001)	(0.001)
INFLATION		−0.001	−0.002		0.013**	0.016***
		(0.002)	(0.002)		(0.005)	(0.003)
RIR		−0.002	−0.002***		0.004	0.006**
		(0.001)	(0.001)		(0.003)	(0.002)
BROADMON		−0.001	−0.004		0.007	0.005
		(0.009)	(0.010)		(0.011)	(0.011)
CRISDUM		−0.036	−0.065		0.007	0.003
		(0.088)	(0.089)		(0.146)	(0.141)
BKCONC			−0.001			−0.002
			(0.001)			(0.005)
FINFREE			−0.002			0.002
			(0.002)			(0.006)
RULEOFLAW			0.111			0.170
			(0.073)			(0.196)
Constant	2.789***	2.732***	3.058***	2.634***	2.079***	2.488***
	(0.157)	(0.132)	(0.235)	(0.202)	(0.136)	(0.437)
Year dummies	YES	YES	YES	YES	YES	YES
R-squared	0.096	0.503	0.547	0.099	0.618	0.672
Observations	427	185	166	181	106	97
Number of countries	43	18	17	28	15	15

This table reports the impact of financial inclusion on financial stability in countries with different levels of financial openness. In panel (I), we use only the sub-sample of countries that liberalize their financial sector more and use the sub-sample of countries that liberalize their financial sector less in Panel (II). The variables are still added progressively into the regressions. All regressions are estimated by using fixed effects estimator for panel data with country and year fixed effects. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Our results for both sub-samples exhibit a positive sign for the coefficients on ACCOUNT but these coefficients are only statistically significant for the sub-group of countries where political stability is high, suggesting that countries characterized by the absence of a real threat of illegitimate violence or say the presence of a constitutional order experience a more pronounced impact of financial inclusion on financial stability. Governments in countries characterized by such high levels of political stability establish relationships with banks by financing and funding them (Jou et al., 2017). While this may reduce their risk-taking, it in turns encourage banks to deploy their services to the most disadvantaged segments of the population as well as in areas not initially covered. Put differently, our results suggest that, in the presence of a politically stable environment, banks are more likely to extend their services to a larger number individuals, which

as a consequence may help reduce their riskiness. The effects of a broader inclusion which are likely to be detected more intensely in these countries will lead to a more sustained stability of the financial system, providing further evidence on the impact of political stability on the linkage financial inclusion-financial stability.

7.3. The effect of different levels of financial openness on the nexus financial inclusion-financial stability

We finally check if the level of financial openness plays any roles in impacting the nexus between financial inclusion and financial stability. Following Bui and Bui (2020) and Rahman et al. (2020), it is posited that financial openness may allow foreign investors to increase their bank deposits, which may be used to mitigate the instability risk. Indeed, foreign banks for instance may have a broader access to international resources. Moreover, they display stable funding and lending patterns than local banks. As they also hold a more geographically diversified credit portfolio, they are less likely to be affected during periods of stress in the host country. Similar to our practice before, we again separate our samples according to the median value of financial freedom (FINFREE) borrowed from the Heritage Foundation and rerun our regressions based on both samples. The results are presented in Table 11. We find that the coefficient on our index of financial inclusion ACCOUNT, when all covariates are controlled for, is positive and significant in the sub-sample of countries characterized by a higher level of financial openness, while it is only positive in the other subgroup. Our results indicate a more pronounced impact of financial inclusion on financial stability when financial openness is high, probably owing to the risk diversification brought by foreign presence in countries which are relatively more open financially.

8. Conclusion

This paper, using country-level data from the GFDD, the Global Findex and the WDI, examines the impact of financial inclusion on financial stability. The results of this study, which covers 54 African countries over the period 2000–2020, suggest that greater financial inclusion (account penetration) promotes financial stability in Africa. This finding accords with the hypothesis that the small savers keep to their financial habit even in periods of crisis, which help reduce dependency by banks on volatile financing, thus making them more resilient to exogenous shocks. Robustness checks including allowing for different sets of control variables, employing alternative measures of both financial inclusion and stability and adopting a different econometric methodology (GMM) are also performed. We find similar to our baseline results that our new measures of financial inclusion namely access to bank credit (LOAN) and money saving (SAVED) promote financial stability in African nations. In the same vein, a higher account ownership reduces the amount of non-performing loans, thus improves bank's performance and maintains stability. We finally go a step further and find evidence that a certain number of factors, namely, income inequality, political stability and financial openness condition the nexus financial inclusion-financial stability.

Policy implications related to our findings call for more cooperation between the regulation and supervisory agency in African countries to push or encourage financial institutions for more inclusion with the aim to grant financial access to those primarily excluded from the classical financial system, which may reduce their riskiness and promote stability. Put differently, policy measures to improve financial inclusion should have the effect of enhancing financial stability; however, the extent to which this movement towards broader financial inclusion should be encouraged remains a question to be investigated in future research. Moreover, future research could also explore key barriers to financial access as identifying them may allow policymakers to set priorities for action while considering the qualitative facet of financial inclusion is crucial when relevant data become available.

Furthermore, with the evolution of the technological environment, the explosion in the number of smartphones in Africa opens up new perspectives and democratizes access to

banking services. Faced with the innovations of operators and new players, and in a boiling market context, traditional banks must adapt to remain competitive as digital banking allows all "classic" banking services to be dematerialized (i.e. consultation, transfers, bank details downloading, etc.) with the objective of facilitating customer procedures, winning new customers reducing bank management costs.

Author details
Yawovi M. A. Koudalo[1]
E-mail: koudgodwin@smail.swufe.edu.cn
Moumbark Toure[2]
[1] Faculty of Economics and Management (FaSeg), University of Lomé, Lomé, Togo.
[2] Faculty of Economics and Management (FaSeg), University of Kara, Kara, Togo.

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Authors' contribution
Yawovi M. A. Koudalo (corresponding author) wrote the main manuscript text including the introduction, the literature review, data collection and the conclusion. Toure Moumbark wrote formal analysis, software and prepared figures and tables. Toure Moumbark and Yawovi M. A. Koudalo did reviewing/editing.

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Notes
1. Originally published in 1997, the Basel principles of Effective Banking supervision serve as a reference for countries to assess the quality of their control system and define the work to be done to achieve a basic level for sound supervisory practices.
2. According to the Alliance for Financial Inclusion (AFI), the basic indicators of financial inclusion covers its two fundamental dimensions: access and use of financial services.
3. The results of the Hausman tests show that the fixed effects model is more suitable than the random effects model. Results are available upon request.
4. Table A1 in Appendix presents the results of the Kaiser-Meyer-Olkin test (KMO). The KMO value of 66.9% suggest that this index could be used in the analysis as suggested by Carillo et al. (2019).
5. WAEMU is defined as the West African Economic and Monetary Union and includes 8 countries namely Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo. ECCAS is the Economic Community of Central African States whose members are Cameroon, Chad, Central African Republic, Congo, Equatorial Guinea and Gabon.

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Appendix

Table A1. KMO test for financial inclusion index (fi) derived from the Principal Component Analysis (PCA). *** significance level of 1%	
Determinant of correlation matrix	**0.000**
Chi2	1963.058***
KMO	0.669