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ORIGINAL PAPER

Effects of financial inclusion on financial stability: evidence from SSA countries

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Abstract

What is the relationship between financial inclusion and financial stability in Sub-Saharan Africa? While prior studies offer mixed evidence, few have explored this link across the region using comprehensive methods. Drawing on data from 37 countries between 2005 and 2019, this study examines how access to financial services affects the stability of the banking sector. We apply dynamic panel techniques that account for cross-country interdependence and heterogeneity, including models that capture effects across different levels of financial stability. We find that greater financial inclusion, especially through expanded bank branch networks, enhances financial stability, particularly in low-income and financially vulnerable countries. Moreover, past financial stability significantly predicts current stability, highlighting the importance of continuity in sound financial systems. These findings suggest that inclusive financial systems can serve as a stabilizing force, and that targeted policies, such as improving financial literacy and expanding access in underserved areas, can strengthen resilience across the region.

Keywords Sub-Saharan Africa · Financial inclusion · Financial stability · Dynamic common correlated effects · Quantile regression

JEL Classification G0 · G2 · G21 · G28

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1 Introduction

Financial stability remains a critical concern for Sub-Saharan Africa (SSA), where the banking sector dominates the financial landscape as the primary mechanism for resource mobilization and allocation (Schinasi 2004; Kulu et al. 2022). Banks not only facilitate most financial transactions but are increasingly expanding into securities markets, insurance, and fund management, progressively blurring traditional sectoral boundaries. This transformation, coupled with intensifying competition, presents a dual-edged sword: while potentially driving financial innovation and efficiency, it simultaneously increases systemic risk exposure that could trigger macroeconomic instability (Allen and Wood 2006; Toniolo and White 2015). The fundamental importance of financial stability in SSA stems from its role in enabling secure value storage, efficient asset transfer, and broad credit access - all essential foundations for economic development (Kulu and Appiah-Kubi 2021). Conversely, financial instability threatens to disrupt economic activity, exacerbate poverty, and compromise long-term development prospects, with these risks being particularly acute in SSA given the region's vulnerability to external shocks, limited regulatory capacity, and persistent financial exclusion.

The concept of financial inclusion has gained significant traction among policymakers and academics since the early 2000 s, building upon foundational economic theories that establish finance as a catalyst for inclusive growth and poverty reduction (McKinnon 1973; Levine 2005). While definitions vary, financial inclusion is generally understood as the widespread availability and accessibility of formal financial services that are affordable, secure, and effectively support system operations (World Bank, 2018; OECD, 2013). By extending services to underserved populations, inclusive financial systems mobilize resources for small businesses and generate positive socioeconomic spillovers (Demirgüç-Kunt et al. 2017; Burgess and Pande 2005). For these reasons, financial inclusion is acknowledged as a vital driver for many of the UN Sustainable Development Goals (SDGs) and the African Union (AU) Agenda 2063.

The relationship between financial inclusion and stability presents a complex duality, with both stabilizing and destabilizing potential[1]. Institutional theory provides a framework for understanding the positive effects, suggesting that broader financial inclusion enhances institutional quality and thereby strengthens financial stability (Meyer and Rowan 1977; DiMaggio and Powell 1983; Ozili 2023). This manifests through multiple channels: by reducing income inequality, improving financial literacy, and driving regulatory reforms that collectively enhance microprudential supervision and system resilience (Arora 2019; Koudalo and Toure 2023). Furthermore, inclusion mitigates information asymmetries in credit markets, stimulates employment growth, and supports broader economic development (Wang and Luo 2022; Ahamed and Mallick 2019). The monetary policy transmission mechanism also becomes more effective in inclusive systems, as banks benefit from diversified deposit bases and more stable balance sheets (Neaime and Gaysset 2018; Han and Melecky 2013).

[1] See Damane and Ho (2024) for a detailed literature review on the relationship between financial inclusion and financial stability.

However, the theory of extreme credit expansion (Morawetz 1908) cautions against potential destabilizing effects when inclusion efforts become excessive. Rapid expansion of financial services to low-income populations may increase transaction costs and system inefficiencies (Khan 2011; Beck and De Jonghe 2013). The challenges intensify when banks outsource credit assessments to serve smaller borrowers, potentially compromising underwriting standards and exposing institutions to reputational risks. Moreover, the proliferation of unregulated financial intermediaries can distort credit markets, weakening assessment protocols and increasing default probabilities - factors that may ultimately precipitate liquidity crises (Khan 2011; Ahmad 2018). This dualistic nature underscores the importance of balanced, well-regulated approaches to financial inclusion.

This study addresses these research gaps through comprehensive analysis of panel data from 37 SSA countries (2005–2019), employing advanced econometric techniques including Dynamic Common Correlated Effects Mean Group (DCCE-MG) and Quantile Regression (QREG) models. Our study makes several important contributions to the literature on financial inclusion and stability in SSA. First, it caters for the presence of unobserved cross-sectional dependence among SSA countries. Existing cross-country research on the influence of financial inclusion on financial stability does not always account for the possibility of panel cross-sectional dependence (see Brei et al. 2020; Al-Smadi 2018; Čihák et al. 2016; Morgan and Pontines 2018; Ahamed and Mallick 2019; Jima and Makoni, 2023). In the recent past, countries in the SSA region have embarked on political agreements to facilitate regional financial integration (RFI) on financial market development, financial stability, and access to finance in SSA. These RFI initiatives are set to culminate in an opening up of capital accounts among countries of geographical proximity as well as the liberalization of cross-border activities of financial institutions within the integrating area (Lovegrove et al. 2007; Bhatia et al. 2009; Frey and Volz 2013). Furthermore, SSA countries are members of various intraregional groupings[2] that foster broader economic integration while also promoting the development of sound regional macroeconomic policies. The resultant intra-regional spillovers suggest the possibility of cross-sectional dependence between countries. There is evidence to suggest that if unobserved cross-sectional dependence is not accounted for in panel data analysis, spurious results can arise (Pesaran 2006; Chudik and Pesaran 2015; Ditzen 2018). Therefore, we fill this gap by employing the Dynamic Common Correlated Effects (DCCE) model capable of detecting and modeling cross-sectional dependency in data while allowing for heterogeneous coefficients and the evaluation of the impact of financial stability in the previous period on financial stability in the current period. This will allow policy makers to avoid sub-optimal policy design that would otherwise prevail if the empirical analysis and subsequent research results ignored the possible existence of cross-sectional dependence. Our results confirm that financial inclusion, particularly through bank branches, positively influences financial stability, and that past financial stability significantly predicts current stability.

[2] These include, the West African Economic and Monetary Union (WAEMU), Economic and Monetary Community of Central African States (CEMAC), Common Market for Eastern and Southern Africa (COMESA), East Africa Community (EAC-5), Southern African Development Community (SADC), Southern Africa Customs Union (SACU), Economic Community of West African States (ECOWAS), to name a few.

Second, we investigate whether financial inclusion affects financial stability differently when levels of financial stability change in the SSA countries. Past studies estimating the influence of financial inclusion on financial stability have relied on classic regression techniques that focus on the mean impacts of financial inclusion on financial stability (see Matsebula and Sheefeni 2022; Anthony-Orji et al. 2019; Al-Smadi 2018; Neaime and Gaysset 2018; Jungo et al. 2022; Jima and Makoni, 2023). As a result, crucial relationships along the conditional distribution of financial stability may be overlooked, underestimated, or overstated (Binder and Coad 2011). To overcome this challenge, we propose a fixed effect panel quantile regression model in addition to linear dynamic panel regression approaches. This enables us to investigate the impact of financial inclusion on financial stability in SSA throughout the conditional distribution while accounting for unobserved individual country variation. For policymakers, this is useful because it enables a nonlinear analysis of the relationship between financial inclusion and financial stability with a focus on how policy can be formulated across different levels of financial stability, and not just the mean. We find that the positive impact of financial inclusion is strongest in countries with lower levels of financial stability, suggesting that inclusion plays a stabilizing role in more vulnerable financial systems.

Third, we examine whether the impact of financial inclusion on financial stability varies along the level of economic development. Recent research examining the relationship between financial inclusion and financial stability in the SSA region has typically focused on a single nation case, a subgroup within the regional group, or a particular income group within the regional group (see Aduda and Kalunda 2012; Amatus and Alireza 2015; Leigh and Mansoor 2016; Arora 2019; Jungo et al. 2022). Furthermore, such research yields conflicting results about the impact of financial inclusion on financial stability across country income levels. In this sense, our research aims to give a comprehensive empirical understanding of how financial inclusion affects financial stability at the regional level and across low, lower-middle, and upper middle-income SSA countries. For policy makers, the granularity brought about by income classification is beneficial for analytical and operational reasons. Analytically, income classification helps in understanding and identifying differences in developmental achievements and processes within countries. Operationally, the classification of countries by income informs better tailoring of policies to country specific circumstances on the basis of evidence. The results show that financial inclusion enhances financial stability in low- and upper-middle-income countries, with ATMs playing a particularly important role in the latter.

Fourth, we investigate whether financial inclusion affects financial stability differently in the SSA countries when different indicators of financial inclusion are used. Most studies on the relationship between financial inclusion and financial stability demonstrate a lack of consistency in the use of inclusion and stability proxies across studies, owing to a lack of similar data across nations or a lack of agreement on a precise definition in each case (see Al-Smadi 2018; Čihák et al. 2016; Morgan and Pontines 2018; Neaime and Gaysset 2018). As a result, drawing parallels and generalizing study outcomes is difficult. To address this issue, the current study employs several proxies of inclusion and stability, to provide a comprehensive and multidimensional view of inclusion and stability in SSA. This study therefore provides helpful inputs to policy makers, bankers, and financial sector regulators to make informed decisions on how best to promote financial inclusion in the region while ensuring financial stability. This is valuable given the current low levels of financial inclusion in most countries in SSA. The results remain consistent across indicators, reinforcing the conclusion that inclusive financial systems contribute to greater financial resilience in SSA.

The remainder of the research is structured as follows. Section 2 presents the methodology and offers the data sources. Section 3 discusses the empirical results. The last section deals with concluding remarks and offers policy recommendations.

2 Methodology and data

2.1 General functional form

Informed by the review of literature and the study's conceptual framework that is enshrined in theory, the general form of our model illustrating the relationship between financial inclusion and financial stability is consistent with the benchmark models used by Amatus and Alireza (2015), Morgan and Pontines (2018), Greene (2001), Brei et al. (2020), and Siddik et al. (2018). Based on these previous empirical studies and their choice of variables, the model that guides the inquiry of how financial inclusion affects financial stability in SSA countries is shown in Eq. 1.

$$FINSTAB_{i,t} = \alpha\, FINSTAB_{i,t-1} + \beta\, INCL_{i,t}, + \gamma\, X_{i,t} + \Omega_{\,i,t} + \vartheta_{\,i,t} + \epsilon_{\,i,t} \quad (1)$$

where $i = 1, \ldots, N$ *and* $t = 1, \ldots, T$, respectively refer to the study's temporal dimension and the panel of nations. $FINSTAB$ is financial stability, the study dependent variable which is proxied by Bank credit to bank deposits (%), Bank Z-scores/distance to default, Liquid assets to deposits & short-term funding (%) and a composite indicator of financial stability, respectively. The same financial stability indicators have been used by Pal and Bandyopadhyay (2022), Jungo et al. (2022), Hakimi et al. (2022), Abdulkarim and Ali (2019), as well as Saha and Dutta (2021).

$INCL$ is a measure of financial inclusion and it is proxied by bank branches per 100,000 adults, and ATMs per 100,000 adults, respectively. The same financial inclusion indicators have been used by Neaime and Gaysset (2018), Khan et al. (2022), Saha and Dutta (2021), and Matsebula and Sheefeni (2022). X is a vector of parsimonious control variables that have a potential effect on financial stability in our baseline model. This includes the logarithm of GDP per capita (which is used as a proxy for economic development), the ratio of private sector credit by deposit money banks and other financial institutions to GDP (which is used to proxy financial sector development), and a measure of inflation.

The selected control variables are commonly used in models that investigate the financial stability and financial development nexus (Brei et al. 2020; Morgan and Pontines 2018; Siddik et al. 2018; Amatus and Alireza 2015). The decision to limit our choice of control variables to these commonly used variables is informed by the desire to easily compare our findings with those of previous studies. A host of other control variables including external debt stocks as a percent of gross national income, gross savings as a percent of GDP and the official exchange rate - local currency unit per US$, period average, as guided by the literature, are considered in the study. α , β and γ are coefficients of the model. The time and country fixed effects are captured with $\Omega_{i,t}$ *and* $\vartheta_{i,t}$, respectively. They control for unobserved time-invariant variation in banking system stability across countries. $\epsilon_{i,t}$ is the error term.

2.2 Dynamic common correlated effects models

The primary objective of our study is to investigate the effect of financial inclusion on financial stability of the banking sector in SSA countries. Historically, methods like the GMM model, fixed effects, and random effects have been used to estimate Eq. 1, but they overlook the possibility of slope heterogeneity and cross-sectional dependency between groups. This is particularly relevant in globalized financial and economic sectors, where policy decisions can impact multiple nations (De Hoyos and Sarafidis 2006; Dogan et al. 2017; Latif et al. 2018). In this regard, the SSA region is implementing political agreements to facilitate regional financial integration (RFI), aiming to develop financial markets and access to finance, leading to spillover effects like capital account opening and cross-border financial institution liberalization (Lovegrove et al. 2007; Bhatia et al. 2009; Frey and Volz 2013). This suggests the possible presence of cross-sectional dependence between the SSA countries in our study. To overcome this challenge, we employ the Dynamic Common Correlated Effects (DCCE) model by Chudik and Pesaran (2015) as our baseline model to estimate Eq. 1. The DCCE-MG estimator is particularly suitable for our study because it accounts for slope heterogeneity, cross-sectional dependence, and non-stationarity in panel data. It also addresses endogeneity through the use of cross-sectional averages and is robust to structural breaks and unbalanced panels (Kapetanios et al. 2011; Ditzen 2016). To mitigate small-sample bias, we apply the jackknife correction method as proposed by Chudik and Pesaran (2015). This approach has been successfully used in similar empirical settings (Chaudhry et al. 2021; Chen et al. 2022).

In dynamic and static panel data models, the DCCE approach is thus robust to endogenous regressors. Furthermore, regardless of whether the regressors are endogenous, strictly exogenous, or weakly exogenous, it considerably enhances the estimator's small sample features in dynamic panel models (Chaudhry et al. 2021). Further, this method can still deliver accurate results even in the presence of structural breaks or unbalanced panel data (Kapetanios et al. 2011; Ditzen 2016).

Our study uses Chaudhry et al. (2021) and Chen et al. (2022) to inform the DCCE model specification. These studies make use of the ability of dynamic panel data models over static models to estimate both short-run and long-run outcomes while also adjusting for the likelihood of cross-sectional dependence among the cross-sectional units. In our investigation, the DCCE model is expressed as follows:

$$L\_FINSTAB_{i,t} = \alpha\, L\_FINSTAB_{i,t-1} + \beta\, X_{i,t} + \sum{}_{p=0}^{P_T} \gamma_{y,i,p} \bar{Y}_{t-p} + \epsilon_{i,t} \quad (2)$$

where i, t refer to the cross-sectional characteristics of the data and the time period, respectively. $L\_FINSTAB$ shows the log of the financial stability indicator, with its lag used as an independent variable. $X_{i,t}$ represents a set of other independent variables, including the financial inclusion proxy, the partialled out cross-sectional means are contained in $\bar{Y}_t$, while, P_T represents the lag of cross-sectional averages and $\epsilon_{i,t}$ is the error term.

The study employs the principal component analysis (PCA) estimation technique to generate the composite indicator of financial stability, following the methodology of Chaudhry et al. (2021), Chen et al. (2022), and Jungo et al. (2022). PCA is a statistical method used to transform multiple correlated variables into a set of uncorrelated components, simplifying the complexity of the data.

In PCA, the jth factor indices are expressed as:

$$FINSTAB\_PCA_j = W_{j1}X_1 + W_{j2}X_2 + W_{j3}X_3 \tag{3}$$

In this context, $FINSTAB\_PCA_j$ represents the financial stability indicator. The corresponding weights for the parameters are denoted as W_j. X_1, X_2 and X_3, refer to values of specific financial stability indicators (namely, Bank credit to bank deposits (%), Bank Z-scores/distance to default, Liquid assets to deposits & short-term funding (%)). The choice of PCA in this study is driven by its ability to condense multiple indicators into a single composite measure, addressing issues of over-parameterization and multicollinearity. This enhances the robustness of our analysis and provides a comprehensive measure of financial stability. Given that financial stability is the dependent variable in our regressions, ensuring an accurate and reliable composite indicator is crucial, which PCA helps achieve.

2.3 The Quantile Regression (QREG) model

Banks are the main source of financial services and products in SSA countries. The stability and development of the banking industry varies among different countries in the region (Anarfo et al. 2022; Mashamba and Gani 2023). In this regard, another objective of our study is to evaluate financial inclusion's impact at different levels of financial stability. To achieve this, we propose using the fixed effect panel quantile regression model. It enables us to account for unobserved individual country variability in our study while examining the effect of financial inclusion on financial stability in SSA across the conditional distribution. Koenker and Bassett (1978) developed the quantile regression method, which uses a semiparametric approach. In contrast to linear regression, it does not assume the distribution of the errors or call for normally distributed data. This increases its resistance to anomalies and non-normal errors (Porter 2014; Petscher and Logan 2014). Additionally, the method is unaffected by monotonic transformations like logarithmic transformations. This is a characteristic that linear regression models lack (Koenker 2005). Depending on the quantile of the result or dependent variable in a quantile regression model, the relevance of the predictors in the model may change (Koenker and Bassett 1978). This indicates that, in the context of our investigation, the effects of financial inclusion as a predictive variable (and those of other independent factors) on financial stability may vary across the various quantiles (or levels) of financial stability in our study countries. In other words, depending on whether financial stability is distributed at a low, average, or high level in each country, the impact of the predictor factors will vary. We adopt the fixed effects panel quantile regression model developed by Koenker and Bassett (1978), which allows us to estimate the effects of financial inclusion across the entire conditional distribution of financial stability. This method is robust to outliers and does not require distributional assumptions. We follow the estimation approach of Machado and Santos Silva (2019), which uses weighted data from the full sample to estimate each quantile. This enhances efficiency and consistency (Oliveira et al. 2013).

2.4 The Augmented Mean Group (AMG) model

We observe that existing studies examining the relationship between financial stability and inclusion in the SSA region currently tend to concentrate on either a single country case, a subgroup within the regional group, or a single income group within the regional group (see Aduda and Kalunda 2012; Amatus and Alireza 2015; Leigh and Mansoor 2016; Arora 2019; Jungo et al. 2022). Such research offers conflicting results about the influence of financial inclusion on financial stability across country income levels. Our study also examines the effects of financial inclusion on financial stability across various country income groups in the SSA region, drawing on the tenets of the institutional theory (Meyer and Rowan 1977; DiMaggio and Powell 1983), which contends that greater financial inclusion, especially in developing economies, promotes the growth of markets essential for economic growth, the reduction of poverty, and financial stability. In this regard, we employ the augmented mean group (AMG) method developed by Eberhardt and Teal (2010) and Bond and Eberhardt (2009), which is a model from the same family as the DCCE estimator used as a baseline model in our study. The AMG estimator, developed by Eberhardt and Teal (2010) and Bond and Eberhardt (2009), is used to complement the DCCE-MG by capturing static long-run relationships across heterogeneous panels. It is robust to cross-sectional dependence and allows for diverse slope coefficients, making it suitable for our income-group analysis (Voumik et al. 2023; Shi et al. 2021).

Despite the advantages of the DCCE-MG estimator, such as accounting for unobserved common factors, heterogeneous factor loadings, and capturing lagged effects and temporal dependencies that the static model might miss, there are notable caveats. These include potential complications in approximating common factors (De Vos and Everaert 2021). In this context, the AMG estimator can be useful for providing insights in a static model setting, particularly when interest is on differences across cross sections rather than changes over time. That is, when the cross sections process unique characteristics that could impact the variable being studied (Chudik and Pesaran 2015) (Chudik and Pesaran 2015; Ditzen 2018). This also allows us to adopt an additional analytical layer that compliments the DCCE-MG in the same way as Musah et al. (2021). The AMG model is used to examine the effects of financial inclusion on financial stability in groupings of SSA countries with low, lower-middle, and upper middle incomes, respectively. It also provides an opportunity for us to introduce additional control variables such as external debt stocks, gross savings, and the official exchange rate, which are often linked to financial stability in the literature (see Eichengreen 1998; Hardy and Pazarbaşioğlu 1999; Sahminan 2007; Donath and Cismas 2008; Obstfeld et al. 2010).

2.5 Data sources and variables

The study makes use of an annual panel of data from 2005 to 2019 and a dynamic panel equation to examine the relationship between financial stability and financial inclusion in 37 SSA nations. A list of the study countries is presented in Appendix Table 7. The number of countries were informed by data availability. The study variables are described in Table 1, together with details on how they were processed and the sources of the data.

The study variables and choice of proxies for financial inclusion and financial stability were informed by the review of relevant literature and data availability. Financial inclusion and stability are the key study variables. Three distinct proxies and a composite indicator are used to approximate financial stability. First, by the percentage of bank deposits to bank credit. The same indicator has been used by Pal and Bandyopadhyay (2022). Second, Bank Z-scores. This indicator depicts the likelihood that a nation's banking system may fail. Studies that have used the same indicator include Jungo et al. (2022); Hakimi et al. (2022); Abdulkarim and Ali (2019) as well as Saha and Dutta (2021). Third, the percentage of liquid assets and short-term funding. This is the proportion of short-term funding and total deposits to the value of liquid assets (easily convertible to cash). Studies that have used the same indicator include Matse-

Table 1 Description of variables

Variables	Symbol	Transformation	Data Sources
Bank credit to bank deposits (%)	$FINSTAB\_1$	Percentage	Global Financial Development Database (GFDD)
Bank Z-scores/ distance to default	$L\_FINSTAB\_2$	Natural log	GFDD
Liquid assets to deposits & short-term funding (%)	$FINSTAB\_3$	Percentage	GFDD
Financial stability indicator	$FINSTAB\_PCA$	-	Authors' calculation using panel PCA based on data from GFDD
Bank branches per 100,000 adults	L_INCL_1	Natural log	GFDD
ATMs per 100,000 adults	L_INCL_2	Natural log	GFDD
GDP per capita	L_GDPPC	Natural log	World Development Indicators (WDI)
Private credit by deposit money banks to GDP (%)	PSC	Percentage	GFDD
Consumer prices (annual %)	INF	Percentage	WDI

Notes: *FINSTAB_PCA* is the composite indicator of financial stability. The composite indicator is calculated using the PCA technique bula and Sheefeni (2022), Siddik et al. (2018) as well as Operana (2016). Two distinct proxies are used to approximate financial inclusion. According to bank branches per 100,000 adults in the first instance and ATMs per 100,000 adults in the second. Studies that have used the same indicators include Neaime and Gaysset (2018), Khan et al. (2022), Saha and Dutta (2021) as well as Matsebula and Sheefeni (2022).

3 Empirical results and analysis

The descriptive statistics for each variable and the pair-wise correlation for all the variables are presented in Appendix Tables 8 and 9, respectively. From Appendix Table 8, the composite measure of financial stability in SSA has a mean value of zero and a standard deviation of almost one. The data shows heterogeneity in the panels, with large standard divisions of private sector credit by deposit money banks and standard deviations of bank credit to deposits and liquid assets. This justifies the use of the panel data techniques that control for individual country heterogeneity. From Appendix Table 9, financial inclusion proxies each have a positive and statistically significant correlation with the financial stability proxies. This suggests that increases in the financial inclusion proxies are anticipated to have a positive impact on the SSA region's financial stability. Noteworthy, the high positive correlation (0.851) between Bank credit to bank deposits and the Financial stability indicator indicates that Bank credit to bank deposits significantly influences the composite indicator. This strong relationship suggests that changes in Bank credit to bank deposits are closely mirrored by changes in the Financial stability indicator, making Bank credit to bank deposits a major component of the overall measure of financial stability. Conversely, the high negative correlation (−0.855) between Liquid assets to deposits & short-term funding and the Financial stability indicator reveals a strong inverse relationship. This means that as Liquid assets to deposits & short-term funding increases, the Financial stability indicator tends to decrease, and vice versa. This suggests that Liquid assets to deposits & short-term funding contributes negatively to the composite indicator, representing a different aspect of financial stability that contrasts with the aspects captured by Bank credit to bank deposits. In summary, the Financial stability indicator effectively integrates information from multiple indicators, reflecting both positive and negative aspects of financial stability. The strong correlations with Bank credit to bank deposits and Liquid assets to deposits & short-term funding indicate that the composite measure is sensitive to variations in these specific indicators, providing a balanced and comprehensive assessment of financial stability.

Before we proceed to the Dynamic Common Correlated Effects (DCCE) model, we first test for the presence of cross-sectional dependence (or weak cross-sectional dependence) using the CD test by Pesaran (2015, 2021). There is sufficient evidence to reject the null hypothesis of weak cross-sectional dependence in favour of concluding that for each variable in the study, the cross-sectional units exhibit strong cross-sectional dependence, as per the results of the Pesaran CD test, which are presented in Table 2.

Table 2 Results of cross-sectional dependence test

	CD
Bank credit to bank deposits (%)	9.790
	(0.000)
Bank Z-scores/distance to default	99.950
	(0.000)
Liquid assets to deposits & short-term funding (%)	19.530
	(0.000)
Composite indicator of financial stability	29.440
	(0.000)
Bank branches per 100,000 adults	73.500
	(0.000)
ATMs per 100,000 adults	68.550
	(0.000)
GDP per capita	22.750
	(0.000)
Private credit by deposit money banks to GDP (%)	41.150
	(0.000)
Consumer prices (annual %)	13.050
	(0.000)

Source: Authors' composition using xtcd2 command in STATA 17

Note: *p*-values in parenthesis. CD is the cross-sectional dependence test by Pesaran (2015, 2021)

3.1 Results of the dynamic common correlated effects model

After confirming that the cross-sectional units exhibit strong cross-sectional dependence, we proceed to evaluate how financial inclusion affects financial stability in the SSA region using the Dynamic Common Correlated Effects Mean Group (DCCE-MG). The DCCE estimator considers cross-sectional dependence and incorporates fixed effects. When combined with the mean group (MG) estimator, it addresses potential slope heterogeneity and produces more robust results (Chudik and Pesaran 2015; Ditzen 2018). Our study recognizes that the performance of the DCCE-MG estimator depends significantly on the time series dimension of the panel, which should be sufficiently large. However, given our limited sample size, we mitigate small-sample time-series bias by applying the jackknife correction method, following the approach proposed by Chudik and Pesaran (2015), similar to Ditzen (2018) and Chen et al. (2022). In Table 3, we display two distinct sets of findings across separate panels, each illustrating different facets of the interplay between financial stability and financial inclusion. Panels 1 and 2 showcase the outcomes of the DCCE-MG estimator, utilizing the natural log of bank branches per 100,000 adults and the natural log of ATMs per 100,000 adults as proxies for financial inclusion, respectively.

In Panel 1 and 2 when financial inclusion is measured by the natural log of bank branches per 100,000 adults, and the natural log of ATMs per 100,000 adults, respectively, the results of model 1 to model 8 show that the lagged dependent variable (i.e., the lag of the composite indicator of financial stability) has a positive impact on financial stability in the SSA region over the review period (see Table 3). Accordingly, holding other factors constant, an increase of 1% point in financial stability from the previous period is expected to lead to an enhancement in financial stability by approximately 0.3 to 0.5% in the current period. This finding aligns with the stud-

Table 3 Dynamic common correlated effects – mean group results

Panel 1: Where Bank branches per 100,000 adults is the Financial Inclusion Indicator	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Regressors	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Lag of composite indicator of financial stability	**0.466*** **	**0.426*** **	**0.390*** **	**0.437*** **	**0.335*** **	**0.437*** **	**0.379*** **	**0.372** **
	(0.057)	(0.066)	(0.061)	(0.062)	(0.066)	(0.007)	(0.067)	(0.072)
Bank branches per 100,000 adults	**0.488***	0.486	−0.189	0.431	−0.149	0.591	0.009	0.057
	(0.265)	(0.315)	(0.302)	(0.268)	(0.240)	(0.467)	(0.241)	(0.271)
GDP per capita		−0.901			−0.947	−1.309		−0.653
		(1.34)			(1.349)	(1.785)		(0.874)
Private credit by deposit money banks to GDP (%)			**0.075*** **		**0.075*** **		**0.071*** **	**0.071*** **
			(0.028)		(0.017)		(0.02)	(0.021)
Consumer prices (annual %)				0.002		0.008	−0.007	0.000
				(0.011)		(0.012)	(0.009)	(0.013)
Observation	518	518	518	518	518	518	518	518
R-Squared	0.76	0.69	0.43	0.72	0.39	0.52	0.31	0.26
Panel 2: Where ATMs per 100,000 adults is the Financial Inclusion Indicator								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Regressors	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Lag of composite indicator of financial stability	**0.345*** **	**0.356*** **	**0.373*** **	**0.427*** **	**0.298*** **	**0.413*** **	**0.355*** **	**0.26*** **
	(0.068)	(0.067)	(0.053)	(0.063)	(0.059)	(0.065)	(0.063)	(0.056)
ATMs per 100,000 adults	−0.067	−0.178	−0.163	−0.127	−0.316	0.617	−0.057	−0.067
	(0.279)	(0.214)	(0.151)	(0.163)	(0.288)	(0.792)	(0.146)	(0.361)
GDP per capita		1.085			−1.023	1.678		−0.385

Table 3 (continued)

		(0.771)			(1.676)	(1.404)		(1.136)
Private credit by deposit money banks to GDP (%)			**0.083****		**0.083****		0.085	**0.082****
			(0.346)		(0.037)		(0.037)	(0.038)
Consumer prices (annual %)				−0.002		0.026	−0.003	0.016
				(0.007)		(0.031)	(0.010)	(0.021)
Observation	518	518	518	518	518	518	518	518
R-Squared	0.58	0.48	0.53	0.50	0.38	0.48	0.35	0.32

Source: Authors' composition using xtdcce2 command in STATA 17

Note: From Model 2 to Model 4, we sequentially introduce the macroeconomic control variables, _ GDP per capita, Private credit by deposit money banks to GDP (%), and Consumer prices (annual %), respectively in that order. In Model 5 and 6 we introduce a combination of the control variables GDP per capita, Private credit by deposit money banks to GDP (%), and GDP per capita, Consumer prices (annual %), respectively. Model 7 introduces a combination of the control variables Private credit by deposit money banks to GDP (%) and Consumer prices (annual %) only. Model 8 includes all the study variables. Coefficients (standard errors) are outside (inside) the parentheses. ***, **, and * denote the statistical significance at 1%, 5% and 10%, respectively. Lag of composite indicator of financial stability denotes the lag of the dependent variable

ies by Morgan and Pontines (2018) and Hakimi et al. (2022), which emphasize the importance of a stable financial system and policies in mitigating economic shocks and maintaining resilience.

The financial inclusion indicator, shows a positive effect on financial stability in six out of the eight models (i.e., model 1, 2, 4, 6, 7 and 8, respectively). However, the effect is statistically significant only in model 1, where a 1% increase in financial inclusion leads to a 0.488% increase in financial stability, *ceteris paribus*. The results are consistent with the findings of Hakimi et al. (2022), Vo et al. (2021), Saha and Dutta (2021), and Abdulkarim and Ali (2019). Conversely, when financial inclusion is measured by the natural log of ATMs per 100,000 adults in panel 2, the impact on financial stability is not statistically significant. This could be due to the preference of financial sector participants in SSA for physical bank branches over ATMs for accessing financial services and products, as noted by Maity and Sahu (2022). The financial intermediation theory supports this, suggesting that increased financial inclusion through bank branches reduces information asymmetry, enhances banking sector competitiveness, reduces operating expenses, increases earnings, and stabilizes the financial system. Additionally, a larger deposit base from retail deposits strengthens sector stability (Čihák et al. 2016; Ozili 2018, 2020; Ahamed and Mallick 2019).

3.2 Quantile regression results

We further examine whether financial inclusion affects financial stability differently when levels of financial stability fluctuate in 37 SSA nations by utilizing a fixed effect panel quantile regression model. In this regard, Table 4 presents two sets of findings

Table 4 Quantile regression results

Panel 1: Where Bank branches per 100,000 adults is the Financial Inclusion Indicator									
Regressors	10th Quantile	20th Quantile	30th Quantile	40th Quantile	50th Quantile	60th Quantile	70th Quantile	80th Quantile	90th Quantile
Bank branches per 100,000 adults	**1.012*****	**0.983*****	**0.957*****	**0.939*****	**0.92*****	**0.895*****	**0.872*****	**0.846*****	**0.816*****
	(0.170)	(0.134)	(0.112)	(0.102)	(0.988)	(0.11)	(0.132)	(0.162)	(0.203)
GDP per capita	**1.019****	**0.881****	**0.763*****	**0.679****	**0.587****	0.469	0.365	0.239	0.099
	(0.448)	(0.353)	(0.291)	(0.266)	(0.261)	(0.291)	(0.344)	(0.426)	(0.532)
Private credit by deposit money banks to GDP (%)	0.016	0.010	0.006	0.002	−0.001	−0.006	−0.01	−0.015	**−0.021***
	(0.011)	(0.008)	(0.007)	(0.006)	(0.006)	(0.007)	(0.001)	(0.01)	(0.013)
Consumer prices (annual %)	0.002	0.001	0.000	0.002	−0.001	−0.002	**−0.003****	**-0.004****	**−0.005****
	(0.002)	(0.002)	(0.001)	(0.006)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
Observation	555	555	555	555	555	555	555	555	555
Panel 2: Where ATMs per 100,000 adults is the Financial Inclusion Indicator									
Regressors	10th Quantile	20th Quantile	30th Quantile	40th Quantile	50th Quantile	60th Quantile	70th Quantile	80th Quantile	90th Quantile
ATMs per 100,000 adults	**0.598*****	**0.572*****	**0.552*****	**0.541*****	**0.523*****	**0.504*****	**0.484*****	**0.458*****	**0.436*****
	(0.109)	(0.085)	(0.071)	(0.064)	(0.061)	(0.064)	(0.077)	(0.1)	(0.122)
GDP per capita	0.776	0.639	0.539*	0.481	0.387	0.292	0.185	0.049	−0.064
	(0.504)	(0.391)	(0.325)	(0.298)	(0.281)	(0.299)	(0.357)	(0.46)	(0.562)
Private credit by deposit money banks to GDP (%)	0.013	0.007	0.004	0.001	−0.002	−0.006	−0.01	−0.012	**−0.019***
	(0.010)	(0.008)	(0.007)	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)	(0.012)
Consumer prices (annual %)	0.002	0.001	−0.000	−0.001	−0.002	**−0.003****	**−0.004****	**−0.005*****	**−0.006*****
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Observation	555	555	555	555	555	555	555	555	555

Source: Authors' composition using xtqreg command in STATA 17

Note: Coefficients (standard errors) are outside (inside) the parentheses. ***, **, and * denote the statistical significance at 1%, 5% and 10%, respectively from the quantile regression (QREG) model, each demonstrating various aspects of the relationship between financial stability and financial inclusion across the entire conditional distribution of the dependent variable. The results of the QREG estimator are displayed in Panels 1 and 2. These panels use different proxies for financial inclusion: Panel 1 uses the natural log of bank branches per 100,000 adults, and Panel 2 uses the natural log of ATMs per 100,000 adults, respectively.

The results here show that the various proxies of financial inclusion across all two panels have a positive impact on financial stability in the SSA region. This finding is similar to that of Kebede (2021). Specifically, the number of bank branches per 100,000 adults, has the highest overall positive impact on financial stability relative to the number of ATMs per 100,000 adults. Maity and Sahu (2022) explain that in the early stages of banks' expansion, bank branches tend to play a greater role in financial inclusion. However, the role played by ATMs in financial inclusion tends to grow and be positive over time. Similar to this, Neaime and Gaysset (2018) draw the conclusion that the ATMs' negligible impact on financial stability may be an indication of the banking sector's underdeveloped access to financial services, which could have a substantial impact on financial inclusion and, consequently, financial stability. Furthermore, Ozili (2021b) makes the point that in some less developed economies, economic agents like using and going to bank branches over ATMs because they appreciate the chance to speak with bank employees since it gives them confidence that their transactions will be handled. They also want to speak with bank employees face-to-face to make sure their issues are addressed.

In all cases, the positive impact of financial inclusion on financial stability decreases from the 10th to 90th quantile. In line with the institutional theory (Meyer and Rowan 1977; DiMaggio and Powell 1983), countries with lower financial stability benefit most from financial inclusion, as it lowers information asymmetry costs and enhances market efficiency (Hannig and Jansen 2010; Ozili 2020; Pham and Doan 2020). Additionally, greater financial inclusion enhances financial supervision and monetary policy transmission, making aggregate demand more sensitive to interest rate changes and encouraging formal, regulated economic engagement (Cull et al. 2012; Ozili 2018; Ahamed and Mallick 2019). Therefore, financial inclusion promotes financial stability by preventing a large informal sector from impeding monetary policy transmission and financial sector supervision (Ozili 2020, 2021a; Pham and Doan 2020; Frączek 2019; Danisman and Tarazi 2020; Kamal et al. 2021; Anarfo et al. 2022).

Including the lagged dependent variable in our model may cause under-confidence in the results since it correlates with the dependent variable (Plümper et al. 2005). Noteworthy, when the lagged value of financial stability is dropped as an independent variable in the model, all indicators of financial inclusion are found to have a positive and statistically significant impact on financial stability across quantiles. This lends credibility to the conclusion that current levels of financial inclusion are important and positive predictors of financial stability in SSA.

3.3 Results of the Augmented Mean Group (AMG) model

The AMG estimator provides an additional analytical layer that compliments the DCCE-MG and quantile regression models. In this regard, we examine whether the level of economic development in the 37 SSA nations influences financial inclusion differentially. That is, we examine how financial inclusion affects financial stability in SSA country groups with low, lower-middle, and upper-medium incomes[3], respectively. The results of the AMG model based on SSA country income groups are presented in two panels in Table 5.

In Panel 1, similar to the results of the DCCE-MG, the impact of financial inclusion as proxied by the number of bank branches per 100,000 adults has a positive impact on financial stability in lower-middle-income countries. In this regard, a 1% increase in increases financial stability by 0.113% points, *ceteris paribus*. A similar finding was discovered by Barik and Lenka (2023). Financial inclusion in lower-middle-income countries boosts job creation, economic growth, and financial sector stability by providing affordable financial services and products, reducing savings withdrawal during crises (Hannig and Jansen 2010; Dienillah et al. 2018). In Panel 2, In contrast to the DCCE-MG, financial inclusion as proxied by the number of ATMs per 100,000 adults is positive and highly statistically significant in all country income groups. ATMs provide economic agents with reliable, affordable physical banking services in less developed financial sectors, enabling better control of financial activities and tracking of

Table 5 Long-run augmented mean group results by country income group

Panel 1			
	Lower-Income Countries	Lower-Middle-Income Countries	Upper-Middle-Income Countries
Regressors	Coefficient	Coefficient	Coefficient
Bank branches per 100,000 adults	0.407 (0.067)	**0.113*** (0.064)	0.025 (0.099)
GDP per capita	0.020 (0.111)	**−0.404**** (0.179)	−0.227 (0.387)
Private credit by deposit money banks to GDP (%)	**−0.190***** (0.005)	−0.003 (0.004)	**−0.006**** (0.002)
Consumer prices (annual %)	−0.001 (0.001)	0.000 (0.001)	0.000 (0.003)
Observation	255	255	255
Panel 2			
	Lower-Income Countries	Lower-Middle-Income Countries	Upper-Middle-Income Countries
Regressors	Coefficient	Coefficient	Coefficient
ATMs per 100,000 adults	**1.794***** (0.031)	**2.063***** (0.509)	**1.779***** (0.112)
GDP per capita	−0.162 (0.152)	**−0.539**** (0.261)	−0.071 (0.204)
Private credit by deposit money banks to GDP (%)	**−0.014***** (0.004)	**−0.006*** (0.004)	**−0.003**** (0.001)
Consumer prices (annual %)	−0.000 (0.001)	0.001 (0.001)	−0.000 (0.003)
Observation	255	255	255

Source: Authors' composition using xtmg command with the amg option, in STATA 17

Note: Coefficients (standard errors) are outside (inside) the parentheses. ***, **, and * denote the statistical significance at 1%, 5% and 10%, respectively

[3] The list of SSA countries by country groups is presented in Appendix Table 10.

spending, especially when adding bank branches comes at a significant cost (Ozili 2021b). A primary factor contributing to the differing outcomes between the AMG estimator and the DCCE-MG estimator could be their respective methods of handling cross-sectional dependence. Specifically, the AMG estimator accommodates variations across different groups, whereas the Dynamic CCE estimator considers unobserved common factors and heterogeneous factor loadings (Chudik and Pesaran 2015).

3.4 Robustness check

As a robustness check, we run the Augmented Mean Group (AMG) model and use three different macroeconomic control variables to those used in our research thus far. This was done in accordance with the literature (see Eichengreen 1998; Hardy and Pazarbaşioğlu 1999; Sahminan 2007; Donath and Cismas 2008; Obstfeld et al. 2010) and the availability of country level data. The variables comprise external debt stocks as a percent of gross national income, gross savings as a percent of GDP and the official exchange rate - local currency unit per US$, period average. The results of the AMG model based on SSA country income groups and three different control variables are presented in two panels in Table 6. The results broadly indicate that financial inclusion positively impacts financial stability, especially in low-income countries with low economic development.

4 Conclusion and policy recommendations

This study aimed to investigate the impact of financial inclusion on financial stability across 37 countries in the SSA region using country-level data that spans from 2005 to 2019. Our analysis confirms the presence of cross-sectional dependence among these countries. The Dynamic Common Correlated Effects (DCCE) model confirms that financial inclusion, proxied by the number of bank branches per 100,000 adults positively impacts financial stability in 37 SSA countries. To add more nuance to the analysis, the Quantile Regression (QREG) model and Augmented Mean Group (AMG) estimator confirm that financial inclusion positively impacts financial stability across low-income and upper-middle income SSA countries and in SSA countries with low levels of financial stability, in line with the institutional theory (Meyer and Rowan 1977; DiMaggio and Powell 1983). Our findings reveal that financial inclusion has a differential impact based on the level of economic development and the specific financial inclusion indicators used. Specifically, the AMG model shows that financial inclusion, as proxied by the number of ATMs per 100,000 adults, has a positive and statistically significant impact on financial stability across all income groups. This highlights the importance of considering different proxies for financial inclusion and their varying impacts on financial stability. Moreover, the study found that the preceding period's financial stability had a favorable and statistically significant influence on the present period's financial stability. This finding underscores the importance of maintaining a stable financial system to provide nations with the financial cushion needed to withstand shocks and efficiently handle crises.

Given these results, policymakers should improve coordination between pertinent regulatory and supervisory organizations to fully enjoy the benefits of financial inclu-

Table 6 Long-run augmented mean group results by country income group with different control variables

Panel 1			
	Lower-Income Countries	Lower-Middle-Income Countries	Upper-Middle-Income Countries
Regressors	Coefficient	Coefficient	Coefficient
Bank branches per 100,000 adults	−0.001 (0.395)	**1.116***** (0.279)	0.158 (0.803)
External debt stocks as a percent of gross national income	**−0.034***** (0.009)	0.003 (0.008)	0.014 (0.009)
Gross savings as a percent of GDP	**0.186***** (0.05)	0.038 (0.029)	0.072 (0.056)
Official exchange rate - local currency unit per US$, period average	**−5.15e-09***** (9.93e-10)	**−1.93r-09***** (5.39e-10)	−7.11e-11 (1.48e-09)
Observation	255	255	255
Panel 2			
	Lower-Income Countries	Lower-Middle-Income Countries	Upper-Middle-Income Countries
Regressors	Coefficient	Coefficient	Coefficient
ATMs per 100,000 adults	**0.654**** (0.328)	0.576 (0.402)	−0.008 (0.614)
External debt stocks as a percent of gross national income	0.004 (0.008)	0.007 (0.007)	0.012 (0.009)
Gross savings as a percent of GDP	0.028 (0.244)	0.019 (0.021)	0.087 (0.057)
Official exchange rate - local currency unit per US$, period average	**−1.44e-09***** (4.26e-10)	**−1.94e-09***** (7.51e-10)	−6.30e-10 (1.45e-09)
Observation	255	255	255

Source: Authors' composition using xtmg command with the amg option, in STATA 17

Note: Coefficients (standard errors) are outside (inside) the parentheses. ***, **, and * denote the statistical significance at 1%, 5% and 10%, respectively

sion. Policies and initiatives aimed at enhancing financial inclusion at the national and regional levels, particularly in low-income and lower-middle-income countries, have the potential to improve financial stability in the region. The DCCE model's detection of cross-sectional dependence suggests that measures taken to advance financial inclusion and stability in one or more countries may have spillover effects on other nations. Governments, supervisors, and regulators should thus develop and use avenues for cross-fertilization of skills and capacities necessary to align with international financial regulatory standards such as the Basel Core Principles for Effective Banking Supervision (BCPs), Basel II, Basel III, and International Financial Reporting Standards (IFRS).

Governments should also build on the advancements made in the creation of national financial inclusion strategies (NFIs) and implement intentional policies to target financially excluded populations, such as small businesses, people living in remote locations, and the poor. While financial literacy is not explicitly modeled in our empirical analysis due to data limitations, it is widely recognized in the literature as a key enabler of financial inclusion and, by extension, financial stability. Therefore, we recommend that governments and financial institutions promote financial literacy—particularly among low-income groups—as a complementary measure to enhance the effectiveness of financial inclusion initiatives.

Appendix

Table 7 List of 37 sub-Saharan African countries used in this study

No.	Country
1	Angola
2	Burundi
3	Benin
4	Burkina Faso
5	Botswana
6	Cote d'Ivoire
7	Cameroon
8	Capo Verde
9	Chad
10	Eswatini
11	Gabon
12	Guinea
13	The Gambia
14	Kenya
15	Lesotho
16	Madagascar
17	Mali
18	Mozambique
19	Mauritania
20	Mauritius
21	Malawi
22	Namibia
23	Niger
24	Nigeria
25	Rwanda
26	Sudan
27	Republic of Congo
28	Senegal
29	Seychelles
30	Sierra Leone
31	South Africa
32	South Sudan
33	Togo
34	Tanzania
35	Uganda
36	Zambia
37	Zimbabwe

Table 8 Descriptive statistics

	Mean	Standard Deviation	Minimum	Maximum
Bank credit to bank deposits (%)	69.504	32.988	−1.050	564.576
Bank Z-scores/ distance to default	2.578	0.052	2.473	2.688
Liquid assets to deposits & short-term funding (%)	38.861	19.498	−35.302	117.226
Composite Indicator of financial stability indicator	0	1.218	−3.939	10.546
Bank branches per 100,000 adults	1.385	0.936	−1.028	4.009
ATMs per 100,000 adults	1.543	1.507	−3.054	4.5
GDP per capita	7.218	0.952	5.599	9.74
Private credit by deposit money banks to GDP (%)	24.525	31.36	−18.967	187.784
Consumer prices (annual %)	8.595	22.36	−8.975	380

Source: Authors' composition using STATA 17

Table 9 Pairwise correlation with probabilities

Variables	Bank credit to bank deposits (%)1	Bank Z-scores/distance to default	Liquid assets to deposits & short-term funding (%)	Composite Indicator of financial stability indicator	Bank branches per 100,000 adults	ATMs per 100,000 adults	GDP per capita	Private credit by deposit money banks to GDP (%)	Consumer prices (annual %)
Bank credit to bank deposits (%)	1.000								
Bank Z-scores/distance to default	0.034	1.000							
	(0.417)								
Liquid assets to deposits & short-term funding (%)	−0.474	−0.061	1.000						
	(0.000)	(0.151)							
Composite Indicator of financial stability indicator	0.851	0.169	−0.855	1.000					
	(0.000)	(0.000)	(0.000)						
Bank branches per 100,000 adults	0.141	0.129	−0.265	0.249	1.000				
	(0.001)	(0.002)	(0.000)	(0.000)					
ATMs per 100,000 adults	0.108	0.51	−0.212	0.242	0.285	1.000			
	(0.011)	(0.000)	(0.000)	(0.000)	(0.000)				
GDP per capita	0.057	0.026	−0.190	0.145	0.688	0.046	1.000		
	(0.183)	(0.539)	(0.000)	(0.001)	(0.000)	(0.280)			
Private credit by deposit money banks to GDP (%)	0.391	0.018	−0.258	0.375	0.463	0.042	0.425	1.000	
	(0.000)	(0.681)	(0.000)	(0.000)	(0.000)	(0.322)	(0.000)		
Consumer prices (annual %)	−0.217	0.037	0.234	−0.255	−0.109	0.048	−0.044	−0.097	1.000
	(0.000)	(0.381)	(0.000)	(0.000)	(0.010)	(0.249)	(0.298)	(0.023)	

Source: Authors' composition using STATA 17

Note: Probabilities are in parenthesis

Table 10 List of Sub-Saharan African countries by country groups

Country	Income Classification
Burundi	Low-Income
Burkina Faso	Low-Income
Chad	Low-Income
Guinea	Low-Income
The Gambia	Low-Income
Madagascar	Low-Income
Mali	Low-Income
Mozambique	Low-Income
Malawi	Low-Income
Niger	Low-Income
Rwanda	Low-Income
Sudan	Low-Income
Sierra Leone	Low-Income
South Sudan	Low-Income
Togo	Low-Income
Uganda	Low-Income
Zambia	Low-Income
Angola	Middle-Income
Benin	Middle-Income
Cote d'Ivoire	Middle-Income
Cameroon	Middle-Income
Capo Verde	Middle-Income
Eswatini	Middle-Income
Kenya	Middle-Income
Lesotho	Middle-Income
Mauritania	Middle-Income
Nigeria	Middle-Income
Republic of Congo	Middle-Income
Senegal	Middle-Income
Tanzania	Middle-Income
Zimbabwe	Middle-Income
Botswana	Upper-Middle Income
Gabon	Upper-Middle Income
Mauritius	Upper-Middle Income
Namibia	Upper-Middle Income
South Africa	Upper-Middle Income

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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