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Article

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BANKING & FINANCE | RESEARCH ARTICLE

The role of regulation in the relationship between financial development and inclusive finance in Sub-Saharan Africa

Victoria Abena Nutassey^{1*}, Mabutho Sibanda¹ and Bomi Cyril Nomlala¹

Abstract: This study seeks to examine the role of regulation in the relationship between financial development and financial inclusion in Sub-Saharan Africa (SSA). Based on available data, the study used 30 SSA economies from 2008 to 2020, employing a generalized method of moments. The study found that as much as financial development enhances financial inclusion directly in SSA and regulation on its own brings more people into the financial system, increasing regulations that restrict financial sector activities in the region should not be above the level of 1.6047, or it would hinder financial development from improving financial inclusion. The study recommends that the financial sector introduce user-friendly products, including low-cost financial services. Second, the central banks of SSA economies can recognise or award financial firms that are the best contributors to financial inclusion. This will encourage other financial firms to do their best. Additionally, policymakers should consider the threshold when employing regulations to enhance financial sector-induced financial inclusion in SSA. Specifically, the study indicates that at least the mean of the current two years of regulations should be computed and compared to the threshold before deciding whether to be more restrictive or not.

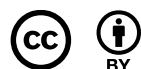
Subjects: Banking; Economics

Keywords: financial inclusion; financial development; regulation; threshold; Sub-Saharan Africa

JEL classification: G20; P37 and G10

1. Introduction

Financial inclusion (FI) is envisioned as being extremely important across every economy because it is considered a catalyst for accomplishing eight of the seventeen Sustainable Development Goals (SDGs) (Ofori-Abebrese et al., 2020). These eight objectives are no poverty, good health, no hunger, decent jobs, gender equality, economic growth, industry and innovation. Yet, the Jombo (2021) indicated that the economies in the Sub-Saharan African (SSA) region have been touted as possessing persistently low levels of access to financial services. This is confirmed statistically by Financial Access Survey (2019), which shows that barely 24% of adults hold a formal financial institution account. From the discourse, even though enhancing FI is crucial to accomplishing SDGs (Ofori-Abebrese et al., 2020; Sen & Laha, 2021), FI in SSA is inadequate, which might hinder achieving SDGs. Hence, the need to investigate how to improve FI in SSA.



Financial development (FD) seeking financial inclusion cannot be underestimated (Kamalu & Ibrahim, 2021). This is because financial markets and financial institutions are the main agents that can make financial services easy and accessible to households, communities, and businesses. By offering credit at a lower cost, giving favourable interest on investment and savings, as well as making automated teller machines, mobile banking and internet banking services available, the financial sector can boost financial inclusion in SSA (Chatterjee, 2020). Financial intermediary theory advocates that the presence of information asymmetries and high transaction costs in the financial sector can impede FI by making financial services unattractive to citizens (Demir et al., 2022). Moreover, Morgan and Pontines (2018) argued that the high cost of borrowing negatively impacts FI. However, the financial sector in SSA is still underdeveloped (Aluko & Ajayi, 2018). For instance, according to World Development Indicators (2022), domestic credit to the private sector as a percentage of GDP reduced repeatedly from 43.99 percent in 2017 to 37.92 percent in 2020. Thus, the underdeveloped financial sector might be a major reason for low financial inclusion in the region. According to Soumaré et al. (2021), an underdeveloped financial system leads to credit restrictions for individuals and businesses as well as low investment rates. Thus, the FD of an economy plays a vital role in FI.

Also, following law and finance theory by Porta et al. (1998), which highlights that vibrant law in an economy enables the financial sector to operate efficiently, the financial sector may not include more individuals in the financial system when there is a poor regulatory system in an economy. According to Aymar and Fabrice-Gilles (2021), regulation and supervision eliminate market failures and lead to greater financial sector efficiency. Thus, an enabling regulatory environment is essential to ensure an inclusive financial system that supports the development of various financial service providers and new delivery channels to meet all residents' financial needs. According to Sohn et al. (2020), poor regulations harm FD by instilling distrust in the financial sector and discouraging people from using financial services more frequently, resulting in lower financial inclusion. Unfortunately, the regulation systems in SSA have been branded weak and not reliable (Bluhm et al., 2020; Union, 2020). Thus, building a strong regulatory system might be a needed strategy for the financial sector to have the desired impact on SSA's FI. Hence, this study analyzes the role of regulations in the relationship between FD and FI in SSA.

Prior studies by Evans (2015) considered the impact of money supply and credit to private sector on FI. Kamalu and Ibrahim (2021) also assessed the influence of total assets of Islamic banks as a percentage of GDP on financial inclusion. In addition, Hlophe (2018) investigated the impact of credit to the private sector on FI. However, a paper by the International Monetary Fund indicated that FD has a complex, multidimensional nature and therefore cannot be measured by one or two indicators (Svirydzenka, 2016), which is the case for the three studies that considered the FD-inclusive financial system nexus. This work contends that representing FD in a study with only money supply and credit to the private sector or with only total assets is woefully inadequate. Also, the three measures of FD (credit to private sector, money supply and total assets to gross domestic products) used by the three studies are one-sided as they all measure only financial depth, ignoring efficiency, stability and concentration in the financial system (Svirydzenka, 2016). Thus, this study takes a noticeably different perspective from Evans (2015), Kamalu and Ibrahim (2021) and Hlophe's (2018) studies by constructing a FD index that summarizes how improved financial institutions and markets are in terms of depth, stability, efficiency and concentration. Hence, this study considers a more comprehensive and representative measure of FD.

The study would further contribute to literature by moderating the relationship between FD and FI in SSA with regulation. Again, unlike earlier studies, this study computed the threshold level that policymaker should consider when employing regulation to strengthen the impact of FD on FI in SSA.

For the rest of the studies, expect the development of hypotheses based on literature review, methodology, discussion of empirical results, hypotheses tested and decisions, conclusions, policy recommendations, limitations, and suggestions for further studies.

2. Development hypotheses based on literature review

The foundation of contemporary financial intermediation theory is that intermediation lowers transaction costs and asymmetries in the financial information of a country. Thus, financial intermediaries, in theory, help to lower transaction costs and increase the ability to obtain accurate information on time in an economy. Residents of an economy avoid using financial services when information asymmetry and cost of transactions are high (Demir et al., 2022). Thus, financial intermediary theory suggests that the presence of information asymmetries and high transaction costs in the financial sector may hinder FI. Thus, financial intermediary theory suggests that information asymmetries and high transaction costs in the financial sector may hinder FI. Thus, the modern financial intermediary theory is essential to this study because it acknowledges that the financial sector's activities might impede FI. This admonishes that FD is the cornerstone of FI since the financial sector is the primary driver of financial services' accessibility and affordability.

The relevance of law to the advancement of the financial sector is highlighted by law and finance theory (Porta et al., 1998). And this argument is guided by the reality that the financial sector responds to the law more effectively in an economy where rules are well-organized, fair, and enforced. Thus, the role of conducive regulations in the developing financial sector of an economy is emphasized. Huang (2010) stated that the supply side of FD is seriously influenced by law. This presages that for an economy to achieve a stronger financial sector, the nature of the law in the economy must be considered. Thus, law and financial theory agree that the presence of a vibrant legal system could enable the financial sector to enhance FI better.

3. Financial development and financial inclusion

Kamalu and Ibrahim (2021) employed causality tests and generalized method of moment to examine the association between Islamic banking development and FI for 30 economies of the Organization of Islamic Cooperation. In their study, they employed total assets of Islamic banks as a percentage of gross domestic product to measure financial development and revealed that Islamic banking improves FI. Also, Hlophe (2018) undertook a causal assessment of FD and FI in Eswatini employing Engle and Granger's cointegration analysis, which examines whether FD causes increased FI. His study confirmed that FD causes financial inclusion by proxying FD with domestic credit to the private sector as a percentage of GDP. Again, Evans (2015) assessed the connection between FD and FI, where money supply and credit to private sector were the measures of FD. Using a fully modified ordinary least square, Evans (2015) established that FD improves FI in Africa. Hence, the study hypothesis that:

H₁: There is a significant positive effect of financial development on FI in SSA.

Unlike the above studies, this study considers a more comprehensive and representative measure of FD by constructing a FD index that summarizes how improved financial institutions and markets are in terms of depth, stability, efficiency, and concentration.

4. Regulation and financial inclusion

Understandably, improving regulation in an economy encourages residents to patronize financial services. This is because regulation reduces information asymmetry, enforces contracts and reduces transaction costs, which results in the protection of residents from adverse selection (Aluko & Ajayi, 2018) which can inspire individuals to access financial services. Empirically:

Yakubi et al. (2022) explained that business regulations drive FI. Again, Gichuru and Namada (2022) establish the influence of regulatory requirements on FI in FinTech companies. Furthermore,

Nguyen and Ha (2021) stipulated, among others, that legal and judicial effectiveness are required for an inclusive financial system. In addition, Eldomiaty et al. (2020) indicated that FI in a feeble regulatory atmosphere creates great risk in terms of unnecessary borrowing and poor consumer protection and therefore leads to financial exclusion. Similarly, Kodongo (2018) studies argue that agency banking regulations improve formal financial access. Barua et al. (2016) stated that regulatory changes are necessary to make the new architecture for FI viable. Chen and Divanbeigi (2019) also indicated that in countries where regulatory quality is heightened, people are more likely to have a financial account. Nonetheless, Anarfo et al. (2020) found that tightening prudential regulations could conflict with SSA economies' FI goals.

Even though prior studies have examined the direct relationship between regulation and FI, they either employed bank regulation measures or general regulation measures from Worldwide Governance Indicators (WDI) (Anarfo et al., 2020; Besong et al., 2022; Nguyen & Ha, 2021); thus, by employing regulation measures from Fraser Institute in this study, unique measures for regulation are explored in examining the direct link between regulation and FI.

From the review, regulation could influence financial access negatively or positively. However, since most of the review studies portray regulation as a necessary tool for reducing financial exclusion. This study hypothesizes that:

H₂: There is a significant positive effect of regulations on financial inclusion in SSA.

5. Financial development and financial inclusion: The role of regulations

According to African Development Report (2020), the regulatory and legal environment is critical for the success of every business (financial institutions and markets) in any country. Thus, financial institutions and markets can flourish in a sound legal and regulatory environment characterized by transparency and strong enforcement institutions and mechanisms. An economy with a reliable legal and regulatory environment reduces transaction costs and non-commercial risks, helps to create fair competition, ensures efficiency and enables stability in the financial sector (Qian, 2017). Various studies have supported this argument:

Bousnina and Gabsi (2022) discovered that the financial sector must be within a sound legal atmosphere for people to benefit from financial systems. Also, Abaidoo and Agyapong (2022) explain that improvements in the elements of institutional quality, such as the rule of law and regulatory values, enhance the efficiency of financial institutions among economies in SSA. Again, Ikpesu et al. (2022) confirm that rule of law and regulations affect banking sector development positively. Moreso, Atanga Ondo and Seabrook (2022) affirmed that implementing sound regulation quality enables FD. Similarly, Aluko and Ibrahim (2021) commissioned the augmented mean group estimator and specified that market regulations induce FD in ECOWAS economies. Likewise, Feng and Yu (2021) indicated that improvements in regulatory quality and the rule of law reduce transaction costs and make the financial operating environment fairer and more efficient. Agreeably, Sarhangi et al. (2021) confirmed a significant positive impact of the rule of law and quality of regulation on FD. Again, Azmeh (2018) discloses that financial sector improvement in an economy is more intense when sound regulation is upheld. Additionally, Muye and Muye (2017) concluded that regulation is a needed factor to boost the financial sector in the BRICS and MINT.

According to Mwege (2016), since the global financial crisis, most economies have strengthened regulations in order to strengthen stability in the financial sector. Congruously, Huang (2010) agreed with most studies that improved regulations can promote FD around the world. In line with the above, Rathinam and Raja (2010) findings show that legal and institutional developments and financial deregulation cause the financial sector to grow. Kombo and Koumou (2021) discovered that the level of FD in the CEMAC is generally lower due to poor regulation and political stability.

Corolla to the discourse on the role of regulation on FD, empirically, the nature of regulation in an economy has a lasting imprint on the efficient operation of its financial sector. Specifically, vibrant regulation has very strong imperatives for monitoring the financial sector and making sure financial institutions and markets within the region are liquid, adequately capitalized, and run in a manner that protects customers while improving the overall health and development of the sector. New institutions theory advocates that regulations shape the operations of firms such as financial institutions and markets in an economy (Meyer & Rowan, 2006). Therefore, the nature of regulation in an economy has a lasting bearing on the efficient operation of its financial sector which in turn reflect in the FI of the residents. In support systems theory of FI by Ozili (2020) states that the nature of sub-systems such as financial and legal systems in an economy would determine the level of FI of that economy. Overall, improved regulation is necessary to propagate the effect of the financial sector on FI in SSA. The argument here is that, although FI may depend on FD, FI would heighten better with the presence of a sound legal system in economies. Yet, no study have examine the role of regulations in the nexus of FD and FI. Thus, the study hypothesizes that:

H₃: *Ceteris paribus*, the presence of sound regulations enhances the relationship between financial development and financial inclusion in SSA.

6. Methodology

This section discusses the data and variables, as well as the estimation technique and model specification.

7. Data and variables

Annual panel data from 30 countries for the period of 2008 to 2020 was employed in this study. The period of the study was guided by the data available for the variables in this study. Table 1 gives details of the variables that were employed in this study and how they will be measured.

8. Estimation procedure

Dynamic Generalized Method of Moments (DGMM) was employed to execute this study (Agyei et al., 2021; Asiamah & Agyei, 2023; Nutassey & Frimpong, 2020). The dynamic estimation technique would circumvent a number of issues inherent in our model specification and data structure. First, the regressand (FI) employed in the study can be persistent. This is because current levels of FI can predict their future. Second, the DGMM is a dynamic specification control for country-specific effects that vary across countries but remain constant over time (Nutassey, 2018). Further, Nutassey et al. (2023), Agyei et al. (2022) and Law and Azman-Saini (2012) argue that all forms of institutions are persistent and pose endogeneity problems that may bias the empirical results. Some of the variables (regulations) employed in the study pertain to institutions (Fraser Institute, 2022). Furthermore, the lag of the regressand was considered a component of the regressors, which also causes endogeneity (Asante et al., 2023). In this regard, the DGMM is efficient in solving the endogeneity concerns that arise from the use of the institution variables (see Arellano & Bond, 1991). Furthermore, the DGMM is more efficient when the cross-sections are larger than the time coverage ($N > T$). The number of countries considered in the study is 30, which is more than the 13-year period (2008–2020). Accordingly, this study employs the two-step GMM estimators (Blundell & Bond, 1998) with robust standard errors. This is more efficient compared to the standard GMM.

However, the consistency of the DGMM depends on the instrument's validity and the absence of autocorrelation. In this case, two-specimen tests are employed to examine the reliability of the estimates: the Hansen test of over-identification restrictions and Arellano and Bond test for second-order serial correlation (AR2) are used to test the null hypothesis that the instruments are valid, and the latter also tests the null hypothesis of no autocorrelation in error. Guided by Nutassey et al. (2023) and Asongu and Acha-Anyi (2019), additional discussion of GMM is made on identification and exclusion restrictions. Identification is selecting the regressand, strictly

Table 1. Variables			
Variables	Meaning and Measurement	Source	Literature justification and sign
Regressand			
Financial inclusion index	It is making financial services and products affordable and accessible to all in an economy. It was computed from the number of deposit accounts with commercial banks per 1000 adults, the number of loan accounts with commercial banks per 1,000 adults, the number of commercial bank branches per 100,000 adults, the number of commercial bank branches per 1000 km ² , the number of ATMs per 1000 km ² , the number of ATMs per 100,000 adults and financial market access index using Principal Component Analysis (PCA).	International Monetary Funds	Kouladoum et al. (2022)
Regressor			
Financial development	It is conceptualized as the depth, efficiency, stability and concentration of the financial sector in an economy. It was computed from financial depth (financial market depth index and financial institutions depth index), financial efficiency (financial market efficiency index and financial institutions efficiency index), financial stability (bank Z-score, bank credit to bank deposits %, liquid assets to deposits and short-term funding %) and financial concentration (Bank concentration % and 5-bank asset concentration) using Principal Component Analysis (PCA).	International Monetary Funds and Global Financial Development	Evans (2015) Positive (+)
Moderating			
Regulation	It reflects the degree to which rules and legal systems in an economy are reliable. Main Estimation Measure Regulation index was created from regulation and legal system and property rights using PCA.	Fraser Institute	Abaidoo and Agyapong (2022) Positive (+)
	Robustness Check Measure Regulation index was computed from regulatory quality and rule of law using PCA.	Worldwide Governance Indicators	
Covariates			
Education	It reflects the proportion of the population that has received formal education in an economy. Secondary school enrollment (% gross)	World Development Indicators (WDI)	Sanderson et al. (2018) Positive (+)

(Continued)

Variables	Meaning and Measurement	Source	Literature justification and sign
Unemployment	It is explained as the share of the labour force that are not working but are ready and looking for employment. Unemployment, total (% of the labour force)	WDI	Tinta et al. (2022) Negative (+)
Gross domestic product per capita	It is the gross domestic product divided by the midyear population. Gross domestic credit per capita	WDI	Zeqiraj et al. (2022) Positive (+)
Population	Total number of people in an economy. Population, total	WDI	Yadav and Sharma (2016) Negative (+)

exogenous, or endogenous explaining variable. Exclusion restriction is whereby the regressand is only affected by endogenous explanatory variables and strictly exogenous ones. Only time-invariant variables are considered strictly exogenous, and all explanatory indicators that fall within exclusive restrictions are classified as either endogenous or preset in terms of the exclusion requirements. It should be highlighted that the time-invariant factors only influence the regressand through the suspected endogenous factor. Additionally, if the null hypothesis associated with the Difference in Hansen Test (DHT) for instrument exogeneity is not rejected, the basic exclusion restriction premise is valid. As a result, the instruments must only affect FI via endogenous factors. The Fisher test should also be significant to show that the models are generally valid.

9. Model development

Following the two-step DGMM estimator with moderation in Kouladoum et al. (2022), the study specifies the models:

$$FI_{it} = \alpha_{it} + \delta FI_{it-1} + \delta B_1 FD_{it} + B_2 REG_{it} + B_3 (FD_{it} \times REG_{it}) + B_4 COV_{it} + u_i + \varepsilon_{it} \quad (1)$$

Where FI is financial inclusion, FI_{it-1} is the first lag of financial inclusion, FD is financial development, REG is regulations, $FD \times REG$ is the interaction between financial development and regulation, and Convari is the covariates (unemployment, education, population growth and economic growth), i is country ($i = 30$), t is period from ($t = 1$ to 13), and is the error term presumed to be serially uncorrelated.

10. Models for net effect and threshold

Net effect and threshold for moderating effect are mostly reported when results are ambiguous and therefore need further clarity. Nutassey et al. (2023) indicated that net effect is the cumulative impact of the regressor and moderating variable on the regressand, while the threshold of an effect is the point at which a moderator's impact on the association between a regressor and a regressand changes in direction. The computation of the threshold is only required if the net impact and the conditional effect move in different directions. This is because it is assumed that when both net and conditional effects move in the same direction, then that direction is apparent. Also, thresholds must fall within the predetermined range for the moderating variable to be accepted. Following Tchamyoun (2019), the net effect and the threshold models are specified as:

$$NE = (B1CE * \bar{XM}) + B2UE \quad (2)$$

$$T = \frac{B_2UE}{B_1CE} \quad (3)$$

NE is net effect, B_1CE is the coefficient of the conditional effect, $\bar{X}M$ is the mean of the moderator and B_2UE is the coefficient of the unconditional effect.

11. Discussion of empirical results

This section presents the study's empirical results and discusses the findings accordingly. It begins with the summary statistics, then the correlation results and ends with the regression.

12. Summary statistics

In Table 2, summary statistics of the data employed were presented to provide pertinent information about the variables employed.

In assessing the performance of FI in SSA, all measures employed to create the financial inclusion index were employed (see the first seven variables in Table 2). The average value of the number of commercial banks per 100,000 adults is 7.120, indicating that out of every 100,000 people in SSA, only 7.120 have access to commercial banks. In support, 8.387 mean for the number of commercial banks per 1,000 km² was recorded. Thus, access to commercial banks in SSA is low. Again, 420.105 average score was recorded for the number of deposit accounts with commercial banks per 1,000 adults, this suggests that the number of deposit accounts in SSA is below average. Also, a poor average score of 113.420 was documented for the number of loan accounts with commercial banks. Moreso, a mean of 14.438 was revealed for the number of ATMs per 100,000, implying that out of every 100,000 people in SSA, only 14.438 have access to ATMs. This is very poor. It was reaffirmed by another poor average score of 14.667 for the number of ATMs per 1,000 km². When it comes to financial market access, again a low access of 0.094 was recorded. From the discussion of the performance of variables employed to assess the performance of FI in SSA, FI in SSA is indeed low as professed by earlier studies such as Chikalipah (2017) and Asuming et al. (2019).

Likewise, in evaluating the performance of FD in SSA, the raw scores of variables employed to create an index for FD were used. Financial institution depth had an average score of 0.160, and financial market depth also had a mean of 0.086; hence, financial depth in SSA is low. Again, financial institution efficiency reveals an average performance of 0.501, while the performance of financial market efficiency remains very low with a mean of 0.046. The stability of the financial sector in SSA gives a mean of 14.585%, 69.700% and 52.258% for bank z-score, bank credit to bank deposits, liquid assets to deposits, and short-term funding. Hence, apart from the bank z-score, bank stability in SSA is above average. In addition, bank concentration recorded a mean of 72.647%, and 5-bank asset concentration documented an average score of 87.104%. Thus, bank concentration in SSA is good. Therefore, in as much as financial development in SSA is doing well in bank concentration, the other indicator mostly revealed poor performance, implying an under-developed financial system in SSA, and this confirms the assertion of Aluko and Ajayi (2018). Hence, the argument of this study that low FD might be the cause of low financial inclusion is validated by the poor average score of the two variables.

Again, the indicators for creating an index for regulation were used to assess the reliability of regulation in SSA. Regulation scored an average of 6.671, while the legal system and property rights scored a mean of 4.448. In all, on a scale of 1 to 10, where 1 is the low level of regulation and 10 is the high level of regulation, the regulation level in SSA is above average while legal system and property right is below average (Fraser Institute, 2022). However, rule of law (-0.602) and regulatory quality (-0.558) separately indicated a poor nature (World Bank, 2022).

With the covariates, unemployment had an average of 8.927, education had an average of 50.039, GDPC had an average of 2750.601 and population had an average of 23,500,000. Hence,

Table 2. Variables' statistics described

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
NCBB100000	378	7.120447	9.271501	.4726674	55.07052
NCBB1000	378	8.386532	22.25739	.004656	111.8227
NDAwCB	378	420.1053	491.7646	.0417441	2946.407
NLAWCB	365	113.4195	153.5612	.213429	642.8558
ATM100000	378	14.43806	42.31035	.0127065	228.5714
ATM1000	378	14.66726	19.39577	.0679605	89.99328
FMA	365	0.0945929	0.1889007	0	0.9154567
FID	339	0.1602954	0.2153917	0.0056185	0.8781426
FMD	352	0.0860133	0.1454131	0	0.7890149
FIE	352	0.5011421	0.111109	0	0.7787408
FME	352	0.0468197	0.1675532	0	0.9921474
BZS	378	14.58466	5.980007	1.643001	27.94649
BCBD	378	69.70007	25.31553	4.557696	130.9451
LADLSF	378	52.25758	31.3422	-16.67457	108.2813
BC	378	72.64698	20.09263	29.10951	104.251
5BAC	378	87.10433	15.12716	44.33098	103.2975
REG	335	6.670887	1.023877	4.073408	8.615148
LSPR	339	4.447795	1.244149	2.123833	6.935325
CoREG (REG +LSPR)	335	0.0000000015	1	-2.536904	1.898921
RoL	372	-0.6017346	.6552205	-2.00266	1.023956
RQ	372	-0.5577064	.6081141	-2.080982	1.196947
CoREG (RoL+RQ)	372	0.0000000802	1	-2.138098	2.481135
UNEMPL	365	8.927348	7.870426	0.6	29.22
EDU	233	50.03917	23.01298	9.68862	109.4441
GDP	373	2750.601	3354.931	198.3529	17252.02
POP	378	23500000	35200000	86956	208000000

NCBB100000 - Number of Commercial Bank Branches per 100,000 adults, NCBB1000 - Number of Commercial Bank Branches per 1,000 km², NDAwCB—Number of Deposit Accounts with Commercial Banks per 1,000 adults, NLAWCB—Number of Loan Accounts with Commercial Banks per 1,000 adults, ATM100000 - number of ATMs per 100,000 adults, ATM1000 - Number of ATMs per 1,000 km², FMAI -Financial Market Access, FID- Financial Institutions Depth, FMD- Financial Market Depth, FIE- Financial Institutions Efficiency, FME- Financial Market Efficiency, BZS- Bank Z-score, BCBD- Bank Credit to Bank Deposits, LADSTF- Liquid Assets to Deposits and Short Term Funding, BC- Bank Concentration, 5BAC-5- Bank Asset Concentration, REG—Regulation, LSPR- Legal System and Property Rights, RoL—Rule of Law, RQ -Regulatory Quality, CoREG—Composite of Regulation UNEMPL—Unemployment, EDU—Education, GDP -Gross Domestic Product per Capita and POP—Population.

the values of GDP and population are very high and therefore outliers; hence, GDP and population were logged to avoid spurious results.

13. Correlation analysis

This section discusses the pairwise correlation results among the variables employed in the study. This provides a preliminary indication of the association among the variables in the study and also assesses the presence of multicollinearity, which could bias the estimates.

From Table 3, the study records significant correlations between FD and FI. This indicates that FI depends on financial development. Likewise, FI relies on regulation since significant correlations were recorded. Again, all the covariates have significant correlations with financial inclusion. In effect, FD, which is employed as the regressor, regulation indicators, which were employed as

moderating variables and all the covariates employed for FI are justified. No matter how high the correlation is between a variable and its regressand, multicollinearity issues cannot take place. However, high correlations among regressors, moderation and covariates can call for multicollinearity issues. Using Kennedy (2008) recommended threshold, which indicates that to avoid multicollinearity, the correlation value should not be more than 0.8. Except for a high correlation of 1.000 between the regulation and the composite measure of regulation, the correlation among regressors, moderation and covariates were below 0.8, and therefore, there was no multicollinearity issue recorded.

The high correlation between regulation and the composite measure for regulation is because regulation was one of the measures used in the computation of the composite of regulation. To avoid possible multicollinearity arising from the two variables, regulation and composite of regulation were employed in two different models (see Tables 6 and 7). For example, in Table 6, regulation was used in Column 1, while the composite of regulation was used in Column 3. Multicollinearity issues would have only occurred if the two highly correlated variables were put in the same model, which this study has avoided.

14. Regression result and discussion

This part of the study discusses Tables 4 and 5. In both tables, results are given in coefficients and standard errors for the variables of interest.

Table 4 depicts the direct association between FD and FI, as well as the direct relationship between regulation and FI. From observation, the diagnostic requirements of GMM are all met: Hansen and Sargan tests failed to reject the assumption of the validity of instruments. Also, Difference-in-Hansen test for instrument exogeneity is accepted. Thus, the entire instruments adopted in the models are valid; again, the probability value of the AR2 test is in favour of the null hypothesis of no autocorrelation, and this means that there is an absence of autocorrelation in the regression results. Furthermore, the lag of financial inclusion is positively related to FI in all of the models in Table 6 indicating autoregressiveness and justifying GMM as an appropriate technique for this study.

In Columns 1 to 3, financial development has a significant positive impact on FI. This means that to increase FI in SSA, the financial sector should be enhanced. The intuition here is that by playing the intermediary role, the financial sector of an SSA makes financial services accessible to households, communities, and businesses (Demir et al., 2022). This is not surprising since obviously, the financial sector of every economy is the main agent in making financial services easy and accessible to households, communities, and businesses. Chatterjee (2020) specifically contended that by offering credit at a lower cost, giving favourable interest on investment and savings, as well as making automated teller machines, mobile banking and internet banking services available, the financial sector could boost FI in SSA. This finding confirms the argument made in this paper that low FD gives birth to low financial inclusion. Hence, this finding corroborates hypothesis 1 that there is a significant positive effect of FD on FI in SSA. Evans (2015), Kamalu and Ibrahim (2021) and Hlophe (2018) agree that FD leads to FI.

Column 1 shows that regulation optimized financial inclusivity, implying that when governments in SSA economies implement regulations that promote the financial sector, more people will be included in the financial system. Column 2 also shows that the legal system and property rights has a positive influence on financial inclusion. Residents will use financial services if the rules governing contracts, property rights, and crime are enforced. Again, Column 3 records a positive direct association between the composite of regulation and FI. This agrees with hypothesis 2, there is a significant positive effect of regulations on FI in SSA. Since regulation is a composite of regulation and the legal system, the result insinuates that overall sound regulation in SSA

Table 3. Pairwise correlations

Variables	FI	FD	REG	LSPR	CoREG	UNEMPL	EDU	LnGDP	lnPOP
FI	1.000								
FD	0.537***	1.000							
REG	0.461***	0.302***	1.000						
LSPR	0.566***	0.321***	0.520***	1.000					
CoREG	0.461***	0.302***	1.000***	0.520***	1.000				
UNEMPL	0.416***	0.410***	0.358***	0.242***	0.358***	1.000			
EDU	0.776***	0.562***	0.389***	0.513***	0.389***	0.590***	1.000		
lnGDP	0.785***	0.581***	0.407***	0.304***	0.407***	0.651***	0.714***	1.000	
lnPOP	-0.577***	-0.315***	-0.215***	-0.152***	-0.215***	-0.503***	-0.345***	-0.473***	1.000

*** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$. FI—Financial Development, REG—Regulation, LSPR- Legal System and Property Rights, CoREG—Composite of Regulation, UNEMPL—Unemployment, EDU—Education, lnGDP -Natural log of Gross Domestic Product per Capita and lnPOP—Natural log of Population.

Table 4. Effect of financial development and regulation on FI

Variable	(1)	(2)	(3)
	FI	FI	FI
L.FI	0.9685*** (0.0183)	1.0211*** (0.0226)	0.9461*** (0.0167)
FD	0.0307*** (0.0084)	0.0470** (0.0200)	0.0469*** (0.0130)
REG	0.0308** (0.0144)		
LSPR		0.0400*** (0.0069)	
CoREG			0.0541*** (0.0207)
Covariates			
UNEMPL	0.0045 (-0.0047)	0.0034 (0.0053)	0.0145* (0.0083)
EDU	-0.0014 (0.0012)	0.0068*** (0.0017)	-0.0024** (0.0011)
LnGDP	-0.0258 (0.0150)	-0.0506** (0.0167)	-0.0613 (0.0720)
LnPOP	0.0347 (0.5524)	-0.0296 (0.02455)	-0.0052 (0.0340)
_cons	0.6062 (0.5524)	0.9670* (0.4816)	0.5445 (0.4703)
Diagnostics			
AR(1)-Pv	0.155	0.150	0.162
AR(2)-Pv	0.168	0.162	0.169
Sargan OIR-Pv	0.791	0.919	0.597
Hansen OIR-Pv	0.399	0.572	0.492
DHT for instrument:			
Hansen test excluding group-Pv	0.581	0.938	0.449
Diff. (null H = exogenous)-Pv	0.310	0.391	0.450
iv(Time, eq(diff))			
Hansen test excluding group-Pv	0.657	0.584	0.417
Diff. (null H = exogenous)-Pv	0.055	0.301	0.646
Fisher test	7589.49***	17027.19***	9047.14***
Instruments	18	18	18
Groups	19	19	19
N	160	162	160

*** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$. Also, L.FI—lag of Financial inclusion, FI—Financial Inclusion, FD—Financial Development, REG—Regulation, LSPR- Legal System and Property Rights, Co REG—Composite of Regulation, UNEMPL—Unemployment, EDU—Education, InGDP—Natural log of Gross Domestic Product per Capita and InPOP—Natural log of Population, OIR—a test for Overid Restrictions, DHT represent Difference-in-Hansen test and AR-Arellano-Bond, Pv- Probability value. Again, N—the number of observations.

economies would help get more people into the financial system. This is because regulation reduces information asymmetry, enforces contracts and reduces transaction costs, which results in the protection of residents from adverse selection (Aluko & Ajayi, 2018). Moreover, regulations instill trust in the financial system of an economy. Thus, regulations play a double role of enhancing the FI activities of the financial sector while also encouraging residents to patronize financial

Table 5. The role of regulations in the relationship between financial development and FI

Variable	(1)	(2)	(3)
	FI	FI	FI
L.FI	1.0424*** (0.0227)	1.0096*** (0.0493)	0.9045*** (0.0143)
FD (Unconditional effect)	0.0516*** (0.1630)	0.2108*** (0.0450)	0.0475*** (0.0160)
REG	0.0013 (0.0191)		
LSPR		0.0095 (0.0242)	
CoREG			-0.0439* (0.0248)
Interaction (Conditional effect)	-0.0809*** (0.0275)	-0.0431*** (0.0149)	-0.0296*** (0.0082)
Net effect	-0.4881	0.0191	0.0475
Threshold	Negative synergy	4.8910	1.6047
Covariates			
UNEMPL	-0.0019 (0.0030)	0.0060 (0.0065)	0.0090 (0.0120)
EDU	-0.0016** (0.0014)	-0.0027*** (0.0025)	-0.0005 (0.0012)
LnGDP	-0.0166** (0.0391)	0.0134 (0.0238)	-0.0004 (0.0819)
LnPOP	-0.0701 (0.0232)	-0.0559** (0.0250)	0.0001 (0.0527)
_cons	1.3966*** (0.3696)	0.9434* (0.5213)	0.0451 (0.5099)
Diagnostics			
AR(1)-Pv	0.144	0.165	0.155
AR(2)-Pv	0.204	0.183	0.149
Sargan OIR-Pv	0.002	0.862	0.706
Hansen OIR-Pv	0.212	0.498	0.729
DHT for instrument:			
Hansen test excluding group-Pv	0.923	0.655	0.265
Difference (null H = exogenous)-Pv	0.150	0.418	0.772
iv(Time, eq(diff))			
Hansen test excluding group-Pv	0.763	0.547	0.638
Diff. (null H = exogenous)-Pv	0.008	0.227	0.866
Fisher test	4260000***	291627.25***	11000.10***
Instruments	18	18	18
Groups	19	19	19
N	160	162	160

*** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$. Also, L.FI—lag of Financial Inclusion, FI—Financial inclusion, FD—Financial Development, REG—Regulation, LSPR- Legal System and Property Rights, Co REG—Composite of Regulation, UNEMPL—Unemployment, EDU—Education, InGDP—Natural log of Gross Domestic Product per Capita and InPOP—Natural log of Population, OIR—a test for Overid Restrictions, DHT represent Difference-in-Hansen test and AR-Arellano-Bond, Pv- Probability value. Again, N—the number of observations.

Table 6. Effect of financial development and regulation on FI

Variable	(1)	(2)	(3)
	FI	FI	FI
L.FI	0.9734*** (0.0232)	1.0428*** (0.0319)	1.0118*** (0.0199)
FD	0.0441*** (0.0131)	0.0300* (0.0165)	0.0569** (0.0208)
RQ	0.1110*** (0.0374)		
RoL		0.1441*** (0.0495)	
CoREG			0.0618*** (0.0156)
Covariates			
UNEMPL	0.0071 (0.0054)	-0.0028 (0.0075)	-0.0060 (0.0082)
EDU	-0.0024** (0.0011)	-0.0068*** (0.0017)	-0.0063*** (0.0018)
LnGDP	-0.0738** (0.0266)	-0.0599** (0.0230)	-0.0345** (0.0223)
LnPOP	0.6605 (0.5725)	-0.0349 (0.0400)	-0.0702* (0.0383)
_cons	0.6605 (0.5725)	1.4701** (0.6615)	1.7606** (0.6436)
Diagnostics			
AR(1)-Pv	0.154	0.147	0.147
AR(2)-Pv	0.160	0.163	0.161
Sargan OIR-Pv	0.843	0.827	0.949
Hansen OIR-Pv	0.684	0.507	0.520
DHT for instrument:			
Hansen test excluding group-Pv	0.470	0.363	0.749
Diff. (null H = exogenous)-Pv	0.656	0.511	0.381
iv(Time, eq(diff))			
Hansen test excluding group-Pv	0.610	0.549	0.428
Diff. (null H = exogenous)-Pv	0.675	0.236	0.859
Fisher test	8155.36***	5188.29***	22666.80***
Instruments	18	18	18
Groups	19	19	19
N	169	169	169

***pv < 0.01, **pv < 0.05 and *pv < 0.1. Also, L.FI—lag of Financial Inclusion, FI—Financial Inclusion, FD—Financial Development, REG—Regulation, LSPR- Legal System and Property Rights, Co REG—Composite of Regulation, UNEMPL—Unemployment, EDU—Education, InGDP—Natural log of Gross Domestic Product per Capita and InPOP—Natural log of Population, OIR—a test for Overid Restrictions, DHT represent Difference-in-Hansen test and AR- Arellano-Bond, Pv- Probability value. Again, N—the number of observations.

services. These findings are in line with Besong et al. (2022), Yakubi et al. (2022) and Gichuru and Namada (2022), who established that regulation plays a positive role in enhancing financial inclusivity.

For covariates, it was observed that education had a significant negative effect on FI. This could be possible if the education system lacks FI. This is because the financial literacy theory of financial inclusion states that FI can be achieved through education that improves financial literacy (Ozili, 2020). In most SSA countries, the education system lacks financial education, which could be the reason for the negative link found between education and FI. Also, lnGDP had an inverse effect on FI. This finding is vindicated by the current discussion that GDP growth in SSA does not affect the income level of the people (Kapoor & Debroy, 2019), resulting in limited income for SSA residents and preventing them from accessing financial services. However, unemployment mostly had no significant relationship with FI while population had no significant influence with FI in all columns.

To explain the role of regulation in the association between FD and FI, the interaction of regulation and FD is presented in Table 5. However, it was observed that the direction of the conditional effects changed to negative from the positive unconditional effect, which contradicts intuition. Hence, additionally, Table 5 presents the net effects and thresholds of the interactions of regulation and FD on FI to avoid ambiguities in reporting the moderating effect (*refer to **Models for net effect and threshold** under methodology to understand how and why the net effect and threshold were calculated*).

- For instance, the net effect of Column 3 (CoREG*FD) of Table 5 is $(-0.0296 \times 0.000000015) + 0.0475 = 0.0475$ (see Table 5 for the other net effects).
- For threshold determination, in Column 1, the net and conditional impacts are both negative, indicating obvious negative synergy; hence, there is no need for threshold determination. In Column 3, however, the conditional effect is negative (-0.0296) but the net effect is positive (0.0376). Therefore, thresholds must be determined. Within a range of -2.5369 to 1.8989 (see Table 2), the threshold for Column 3 is $0.0475/0.0296 = 1.6047$.

Continuing with the discourse of the results, Column 1 reports a negative synergy of regulation and FD (REG*FD) on financial inclusion. Column 2 demonstrates a positive net effect of legal system and property rights and FD (LSPR *FD) on FI; however, at a threshold of 4.8910, it starts having an adverse effect on FI. Finally, the net influence of the overall measure of regulation and FD (CoREG*FD) on FI was also recorded in Column 3 as positive but changed to negative at a threshold of 1.6047. This implies generally introducing regulation in SSA starts by causing FD to improve FI but as it increases over a coverage of 1.6047, it hinders the financial sector from improving FI in the region. Consequently, regulation induced financial sector-enhanced FI in SSA could be good at a certain point and barrier at another point. Hence, the finding partially supports hypothesis three, which indicates that the presence of sound regulations improves the relationship between FD and FI in SSA.

In as much as certain studies' findings indicate that regulation boosts the efficient operations of financial sector services (see Abaidoo & Agyapong, 2022; Bousnina & Gabsi, 2022; Ikpesu et al., 2022) which is in line with law and finance theory (La Porta, Lopez-deSilanes, Shleifer, & Vishny, 1997, Porta et al., 1998), this study further considered the threshold effect of regulation. Hence, based on our findings, this paper argued that, yes, regulation in SSA can help boost the impact of financial sector on FI because it helps eliminate market failures and leads to greater financial sector efficiency (Aymar & Fabrice-Gilles, 2021) but as these strict regulations (restrictions) covers a threshold 1.6047 it turns to align with the school of thought that preaches lessening regulation (freedom) to enhance financial sector's financial inclusivity agenda. Financial liberalization theory by McKinnon (1973) and Shaw (1973) posits that financial services are improved in a free economy. The thinking here is that if there is an increase in the regulations of SSA (with specific emphasis on those that limit the financial sector) above a threshold of 1.6047, the activities of financial firms would be hindered. For instance, if regulations have high requirements for starting a business, then establishing new financial institutions and new branches for existing financial institutions would be stalled. Again, if a country's tax laws are too harsh on businesses, financial institutions will be discouraged from going above and beyond to make financial services available to residents. In

Table 7. The role of regulations in the relationship between financial development and FI

Variable	(1)	(2)	(3)
	FI	FI	FI
L.FI	1.0197*** (0.02235)	0.9476*** (0.0384)	1.0103*** (0.0216)
FD	0.0302** (0.0123)	0.1534** (0.0542)	0.0802*** (0.0190)
RQ	0.1043** (0.0405)		
RoL		0.1402*** (0.0375)	
CoREG			0.0675*** (0.0192)
Interaction	0.0113 (0.0062)	0.1633*** (0.0514)	-0.0732*** (0.0200)
Net effect	0.0239	N.A	0.0802
Threshold	Positive synergy	N.A	1.0956
Covariates			
UNEMPL	0.0016 (0.0062)	0.0038 (0.0061)	-0.0042 (0.0070)
EDU	-0.0047** (0.0018)	-0.0056*** (0.0015)	-0.0084*** (0.0023)
LnGDP	-0.0686** (0.0251)	-0.0425 (0.0286)	-0.0819** (0.0301)
LnPOP	-0.0393 (0.0330)	0.0029 (0.0267)	-0.0394 (0.0301)
_cons	1.4332** (0.6212)	0.5447 (0.4415)	1.6564 (0.5828)
Diagnostics			
AR(1)-Pv	0.149	0.139	0.130
AR(2)-Pv	0.155	0.142	0.140
Sargan OIR-Pv	0.763	0.926	0.960
Hansen OIR-Pv	0.545	0.908	0.872
DHT for instrument:			
Hansen test excluding group-Pv	0.315	0.222	0.765
Diff. (null H = exogenous)-Pv	0.550	0.959	0.813
iv(Time, eq(diff))			
Hansen test excluding group-Pv	0.457	0.861	0.805
Diff. (null H = exogenous)-Pv	0.722	0.749	0.935
Fisher test	9908.50***	2548.31***	5852.24***
Instruments	18	18	18
Groups	19	19	19
N	169	169	169

****pv* < 0.01, ***pv* < 0.05 and **pv* < 0.1. Also, L.FI—lag of Financial Inclusion, FI—Financial Inclusion, FD—Financial Development, REG—Regulation, LSPR- Legal System and Property Rights, Co REG—Composite of Regulation, UNEMPL—Unemployment, EDU—Education, InGDP—Natural log of Gross Domestic Product per Capita and InPOP—Natural log of Population, OIR—a test for Overid Restrictions, DHT represent Difference-in-Hansen test and AR-Arellano-Bond, Pv- Probability value. Again, N—the number of observations.

Table 8. Hypotheses tested and decisions

Hypotheses	Decisions
H ₁ : there is a significant positive effect of financial development on FI in SSA.	Supported
H ₂ : there is a significant positive effect of regulations on FI in SSA.	Supported
H ₃ : Ceteris paribus, the presence of sound regulations enhances the relationship between financial development and FI in SSA.	Partially supported

support of this Anarfo et al. (2020) established that tightening regulations could conflict with SSA economies' financial inclusion goals. Also, the findings of (Raksmey et al., 2022) also suggests that in developing countries, excess regulation adversely affects access to the credit market. Agreeably, Hafer (2013) argued in that economic freedom enhances the financial sector's development. Hussain et al. (2021) also found that extreme restrictions on economic activities hinder access to finance.

Like Table 6, most of the models in Table 7 met all the necessary diagnostic requirements of DGMM.

15. Robustness check

To test the robustness of the outcomes, the study used the Worldwide Development Indicator's regulatory quality and rule of law instead of the Fraser Institute's regulation and legal system and property rights. The study still recorded that both FD and regulation in isolation optimized FI (see Table 6), but regulations have a positive role on the effect of FD on FI up to a threshold of 1.0956, after which it turns negative (see interaction in Column 3 of Table 7). The outcomes of this investigation can be trusted because the obtained results were consistent with the major findings.

16. Hypotheses tested and decisions

This study presents the decisions made on all the hypotheses tested in Table 8.

17. Conclusions and policy recommendations

This paper analysed the role of regulation in the link between financial development and financial inclusion in SSA. The study found a significant positive direct effect of financial development on FI and a direct positive influence of regulation on FI, but it also discovered a significant positive role of regulation in the relationship between financial development and financial inclusion at a threshold of 6.3354. Hence, in as much as financial development enhances financial inclusion in SSA and regulation on its own brings more people into the financial system, increasing the regulations that restrict financial sector activities in the region should not be above the level of 6.3354 or it would hinder financial development from improving financial inclusion. The paper recommends that first, the financial sector should introduce user-friendly products, including low-cost financial services that overcome distance barriers. Second, the central banks of SSA economies can recognise or award financial firms that are the best contributors to financial inclusion. This will encourage other financial firms to do their best. Additionally, the study recommends when employing regulations (especially those that limit the services of the financial sector) to enhance financial sector enhance financial inclusion in SSA, policymakers should take the threshold into consideration. Specifically, policymakers should always check the mean of the regulations in their country before deciding whether to be more restrictive or not. Tchamyou (2019) indicates that the mean of the current two years would help make more appropriate and current policies.

18. Limitations and suggestions for further studies

In as much as the financial development index employed in this paper is comprehensive (depth, efficiency, stability and concentration) compared to previous studies, competition was not included due to the time period employed. Also, it cannot be denied that the main platform through which

most SSAs have been involved in the financial system is the mobile money platform. Yet, this paper was not able to include mobile money usage in the calculation of the financial inclusion index because the date range for mobile money is just three years, which is insufficient for the time period and the number of countries considered in this paper. Apart from the listed limitations, all efforts were made to come out with a robust result that can help policymakers enhance financial inclusion in SSA. Based on the limitations of the paper and its findings, the following research suggestions are put forth: other researchers can include competition measures to the indicators employed in computing financial development index in this paper; other studies can also consider mobile money in the computation of the financial inclusion index; and finally, other researchers can examine the role of freedom in the relationship between financial development and financial inclusion in SSA. This can help reaffirm the argument made in support of the final finding in this paper.

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