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FINANCIAL INCLUSION TOWARDS FINANCIAL STABILITY IN GHANA: INSIGHTS FROM QUANTILE REGRESSION ANALYSIS

Keywords: financial inclusion, financial stability, cointegration quantile regression, Ghana.

Jel Classifications: G28, O16, O55.

Abstract: In Ghana, only 52.7% of the population is fully financially included in the formal financial system. However, while financial inclusion is often linked to economic resilience and stability, as it can broaden access to financial services and reduce vulnerability, its direct, quantifiable impact, particularly at different quantile levels, remains largely untested in the sub-Saharan African context. This study addresses this gap by employing quantile regression analysis to examine the impact of financial inclusion on Ghana's financial stability, using time-series data from 2005 to 2021. The results show significant cointegration between the variables, indicating that the independent vari-

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ables act as long-run forcing factors for financial stability. The long-run analysis shows that financial inclusion positively affects financial stability, especially at higher quantiles. These findings highlight the need to consider various quantile levels in national financial assessments. The study suggests prioritizing financial inclusion during periods of low financial stability because of its positive correlation with strengthening a country's financial landscape, which can aid in economic resilience and sustainability in Ghana and many sub-Saharan African countries.

Introduction

Financial inclusion is essential for financial stability, as 1.7 billion people remain unbanked globally, with Ghana among seven countries representing nearly 50% of the unbanked population (Global Financial Index Report, 2017). Financial inclusion can reduce financial fragility and enhance stability (Camara & Diallo, 2020). However, Ghana's significant financial exclusion, with substantial amounts of money outside the banking system, has resulted in pronounced financial instability. Financial instability has been a recurring issue for over 20 years. In Ghana, this instability has worsened due to the lingering effects of the COVID-19 pandemic, influencing inflation and debt sustainability. Additionally, the domestic debt exchange program (DDEP) of the Government of Ghana (GoG) has failed to achieve financial stability, leading to a bailout request from the IMF in 2023.

Financial inclusion is crucial for achieving financial stability (Koudalo & Toure, 2023). Policymakers consider various factors, such as inflation, recession, policy changes, political situations, global markets, fiscal deficits, and financial inclusion, to address financial stability. Financial inclusion enhances the financial sector and provides access to services such as credit, thus strengthening stability (Moeti & Sin Yu, 2024). While numerous studies have investigated the factors influencing financial stability (Frimpong, Yusuf, Boateng, Ankomah & Abeka, 2023), including financial inclusion (Babatunde, 2024), research on the financial inclusion-stability relationship in developing countries such as Ghana is limited. As of June 2022, only 52.76% of Ghana's population had access to formal financial services (Sackitey, 2024). Moreover, existing studies in this field have rarely used the quantile regression approach to analyze this relationship. Feghali, Mora and Nassif (2021) further suggest that a general measure of inclusion is insufficient to assess financial inclusion-stability effects.

Quantile regression is a crucial tool for studying financial inclusion and stability, because it enables the measurement and analysis of these concepts at various quantiles. Specifically, it allows for a comprehensive assessment of financial stability across different levels of financial inclusion (Olusegun, Evbuomwan & Belonwu, 2021). Furthermore, quantile regression can facilitate the examination of financial inclusion in Ghana at diverse income-level quantiles. By employing quantile regression, policymakers and stakeholders can gain insights into the relationships, dynamics, and potential disparities in financial inclusion and stability across various income segments in Ghana (Ibrahim, Mazlina, Az-Saini & Zakaria, 2016). This approach provides a different understanding of the effect of income levels on financial inclusion, and allows for targeted interventions that can help promote inclusive and stable financial systems in Ghana. Thus, a missing explanation in empirical literature is that financial inclusion affects stability at various levels of financial inclusivity. Consequently, this study analyzed the following:

(1) short-run financial inclusion – financial stability relationship;
(2) long-run financial inclusion – financial stability relationship; and
(3) effect of financial inclusion on financial stability at different quantiles.

Literature Review

Financial Inclusion (FI)

Financial inclusion, defined as the percentage of individuals and firms using financial services, has garnered the interests of stakeholders, scholars, and policymakers. A World Bank global payment system survey in 2021 indicated that international forums, such as G-20, emphasize its importance for social and economic development (World Bank, 2021). Fifty nations have recently established financial inclusion goals, recognizing their role in reducing poverty, fostering prosperity, and promoting sustainable development. In 2016, the World Bank noted that over 2.5 billion people lacked formal financial accounts, with half the adult population without financial services, revealing significant access gaps (World Bank, 2021). Consequently, poor families often rely on informal sources such as friends, relatives, savings plans, moneylenders, and cash. Financial inclusion, often associated with access to credit from official institutions, has various dimensions that influence financial attitudes (Babatunde, 2024; Kamal, Hussain & Khan, 2021). Formal accounts, including deposits and loans, can be assessed on the basis of purpose, access type, and usage frequency. Alternatives include mobile money and insurance services in agriculture and health (Demirgüç-Kunt & Klapper, 2012). Financial exclusion imposes high costs on those in need (Cull, Ehrbeck & Holle, 2014). In regions such as Ghana and sub-Saharan Africa (SSA), financial inclusion is crucial for reducing dependence on informal loans and enabling savings (Kamara, 2024), with reliable rural financial services essential for economic growth and supporting rural livelihoods.

Financial Stability (FS)

The World Bank defines financial stability as the absence of a systemic failure in the financial system, signifying resilience to stress. It involves smooth operation of the system, with effective monitoring and management of financial risks to prevent crises (Babar, Latief, Ashraf & Nawaz, 2019). To grow their financial and economic sectors, countries enhance their financial inclusion and provide access to financial services (Anthony-Orji, Orji, Ogbuabor, Mba & Onwe, 2021). Le, Chuc and Taghizadeh-Hesary (2019) highlight that financial inclusion offers affordable, need-based financial services. Interest in financial stability intensified among academics and policymakers during the 2007–2009 economic crisis, and resurfaced during the COVID-19 pandemic (2019–2021), causing another global financial crisis. Research shows that financial stability is vital for a country's development and sustainability (Kamal et al., 2021).

Financial Inclusion and Financial Stability

Frequent inquiries suggest that financial inclusion enhances financial stability. Anthony-Orji et al. (2021) assert that diversifying bank assets reduces risk and bolsters resilience. Atellu and Sule (2019) find that greater access to financial services strengthens the deposit base and stabilizes financial institutions. Financial inclusion improves monetary policy transmission, reduces credit risk and default likelihood, promotes economic activities, enhances risk management, and positively impacts socioeconomic well-being in developing countries (Antwi, Kong & Gyimah, 2024; Yangdol & Sarma, 2019). Financial inclusion plays a vital role in economic growth (Ahamed & Mallick, 2019). However, some argue that it may lower lending criteria, contributing to financial crises (Camara & Diallo, 2020).

Neaime and Gaysset (2018) found a positive correlation between financial stability and the number of banks, challenging the notion that increased financial inclusion is risky. Effective regulatory frameworks are crucial because inadequate regulation can lead to negative outcomes (Kamal et al., 2021). Balanced regulations are essential to maximize the benefits of financial inclusion while mitigating risks. Feghali et al. (2021) support the findings of Ahamed and Mallick (2019) and Canlas, Ravalo and Remolona (2025), emphasizing the importance of nuanced measures in assessing the impact of financial inclusions, especially through increased deposits. Regional studies indicate that financial inclusion positively impacts financial stability in sub-Saharan African countries (Djoufouet & Pondie, 2022; Moeti & Sin Yu, 2024), the Asian banking sector (Vo, Van, Dinh & Ho, 2021), and the European Union (Danisman & Tarazi, 2020).

Existing literature indicates a complex relationship between financial inclusion and stability, highlighting both positive and negative effects. Although empirical evidence typically indicates a positive correlation, these findings emphasize the need for well-designed regulatory frameworks and targeted measures. Understanding the dynamics between financial inclusion and stability is essential for policymakers, regulators, and financial institutions in fostering inclusive and resilient systems.

Methods

Research Design

This explanatory study employed a quantitative method to identify cause-and-effect relationships between variables (Saunders, Lewis & Thomhill, 2012). It investigates the link between financial inclusion and stability using secondary data (Koudalo & Toure, 2023). The analysis uses time series data from 2005 to 2021, including the Bank's Z-score, the volume of outstanding deposits with commercial banks (% of GDP), outstanding loans from commercial banks (% of GDP), the Overall Consumer Price Index, and the Central Bank policy rate in Ghana, sourced from the World Bank, the International Monetary Fund, and the Bank of Ghana website.

Measurement of Variables

Measurement selection for this study's variables was based on their prevalent use in existing literature. Financial inclusion, the independent variable, is measured by the volume of outstanding deposits and loans as a proportion of GDP, representing the ratio of total funds in deposits and loans within a country's banking system relative to GDP. Financial stability, the dependent variable, is measured using the Z-scores of various financial institutions in Ghana. The Z-score, created by Edward Altman in the late 1960s as a bankruptcy prediction model, indicates an institution's financial health and risk. Although initially used to predict corporate bankruptcy, it is now used to assess financial institutions' creditworthiness and stability. Additionally, four macroeconomic indicators – inflation, recessions, interest rates, and policy changes – are included to provide a broader context and to assess their impact on the relationship between financial inclusion and stability in Ghana's financial sector. The variables are defined as follows: FI = financial inclusion; FS = financial stability; INF = inflation; RE = recession; R = interest rate; PC = policy changes.

Table 1. Variables and Measurement

Variable	Measurement	Source
FI	Usage of Financial Service (Using the volume of outstanding deposits with commercial banks (% of GDP) and outstanding loans from commercial banks (% of GDP))	Financial Access Survey (FAS)
FS	Bank's Z Score	Global Financial Development
INF	Overall Consumer Price Index (Non-food and Food)	World Development Indicators
R	Central Bank policy rate	World Development Indicators

Source: fieldwork 2022.

Estimation and Analysis Technique

Quantile regression (QRM) is employed to investigate the association between FI and financial stability FS, offering a unique approach compared to traditional methods, such as linear regression (LRM), autoregressive distributed lag

(ARDL), and vector error correction models (VECM). The QRM overcomes the limitations of these models, which often yield biased results and inaccurate hypothesis testing when data are not normally distributed, by avoiding normality assumptions (Koenker & Hallock, 2001) and minimizing asymmetrically weighted absolute residuals (Koenker & Bassett, 1978), thus providing more reliable country-specific policy recommendations during the different stages of FI and FS.

ARDL and VECM require strict integration conditions (I(0) or I(1) for ARDL and I(1) for VECM, respectively), limiting their use if the variables exceed these orders (Anokye & Peterson, 2017). In contrast, QRM can be used regardless of integration order or variable differentiability (Koenker & Hallock, 2001). This study emphasizes the assessment of variable stationarity before choosing a time-series estimation method. Stationarity was tested using the augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) tests, differing only in the autocorrelation correction method for residuals. Both tests compare the alternative hypothesis of no unit root with the null hypothesis that the variables have a unit root.

The ADF and PP formulations are given in models 4 and 5 as follows:

$$\Delta Y_t = \mu + \delta_t + \rho Y_{t-1} + \sum_{i=1}^{p} \psi_i \, \Delta Y_{t-1} + \varepsilon_t$$

$$\Delta Y_t = \mu + \delta_t + \rho Y_{t-1} + \psi_i Y_{t-1} + \varepsilon_t$$

Y_t represents the series at time t; Δ is the difference operator; μ, δ, ρ, and ψ are the parameters to be estimated; and ε is the error term. The hypotheses test was as follows:

H0: ρ = 0 (series contains unit root, non-stationary)

H1: ρ ≠ 0 (series has no unit root, indicating stationarity).

The null hypothesis (Ho) is accepted if the estimated t-values are less negative in absolute terms than the critical Dickey-Fuller (DF) values, indicating that the series has a unit root or is integrated beyond order one, or I(1). If the t-values are more negative than the critical DF values, the null hypothesis (Ho) is rejected in favor of the alternative hypothesis (H1), suggesting that the series does not have a unit root or is not integrated beyond order one or I(1).

Quantile Regression Analysis

The primary analysis of the financial stability and inclusion relationship was conducted using QRM. QRM is more suitable than classical LRM in assessing the impact of financial inclusion on financial stability across various stability stages. This is significant because differing financial development policies may be necessary based on the severity of economic growth. This study investigates this relationship at varying levels of financial stability and enhances the quantile regression model proposed by Koenker and Bassett (1978). The quantile regression function is as follows:

$$Q_\tau(FS_i|X_i) = \beta_\tau X_i$$

FS denotes financial stability and X is a vector of independent variables. This equation represents the conditional mean equation. By solving the following optimization problem, the QRM parameters at the τth quantiles are estimated:

$$\min \sum_{i\in\{i:FS_i \geq \beta_\tau X_i\}} \tau \mid FS_i - \beta_\tau X_i \mid + \sum_{i\in\{i:FS_i < \beta_\tau X_i\}} (1-\tau) \mid FS_i - \beta_\tau X_i \mid$$

Auto Regressive Distributed Lag Analysis

This study employs quantile regression analysis and the ARDL technique to analyze the relationship between financial stability and financial inclusion in Ghana. This method is effective regardless of whether the variables are I (0), I (1), or their integration sequence. The initial step in ARDL modeling involves estimating the following equation: ARDL is defined using a time-series approach.

$$\Delta FS_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \, \Delta FS_{t-i} + \sum_{i=0}^{n} \emptyset_i \, \Delta OD_{t-i} + \sum_{i=0}^{n} \Phi_i \, \Delta FI_{t-i} + \sum_{i=0}^{n} \propto_i \Delta INF_{t-i} + \sum_{i=0}^{n} \sigma_i \, \Delta OL_{t-i} + \partial_1 FS_{t-1} + \partial_2 OD_{t-1} + \partial_3 FI_{t-1} + \partial_4 INF_{\ t-1} + \partial_5 OL_{\ t-1} + \varepsilon_t$$

Where FI represents financial inclusion, FS represents financial stability, INF represents inflation, RE represents recession, and R represents the interest rate. The ARDL bounds test is used to evaluate the potential existence of a long-term relationship. The alternative hypothesis indicates a long-run relationship, while the null hypothesis suggests no integration. The null hypothesis was rejected if the estimated F-statistic exceeded the upper critical value. The optimal lag length for the long-run model was selected using the Hannan-Quin (HQ) and Akaike Information Criterion (AIC).

Empirical Analysis and Results

Table 2. Descriptive Analysis

	D_R_	Z_SCORE	OL	OD	INF_D
Mean	11.7889	12.8085	15.3294	22.3571	20.8105
Median	11.5729	13.1927	15.3317	22.3733	15.115
Maximum	17.4752	14.7706	22.3622	26.945	89.0766
Minimum	8.52025	9.52205	11.53	16.4438	-41.434
Std. Dev.	2.1167	1.42511	2.59483	2.7292	21.5054
Skewness	0.53887	-0.8345	0.40634	-0.1868	1.51229
Kurtosis	3.33449	2.71352	2.48025	2.50573	6.52602
Jarque-Bera	3.60801	8.1249	2.63664	1.0875	61.1458
Probability	0.16464	0.01721	0.26759	0.58057	0
Sum	801.642	870.976	1042.4	1520.28	1415.11
Sum Sq. Dev.	300.188	136.073	451.121	499.051	30986.4
Observations	68	68	68	68	68

Source: field survey 2022: analyzed with EViews 12.

Looking at the descriptive analysis above, based on the Jaque-Bera test of normality, financial inclusion, financial stability, interest rate, and inflation are not normally distributed. The average values are listed in table 2. This means that not all the variables are normally distributed.

Correlation Analysis

Table 3. Correlation Matrix

	D_R_	Z_SCORE	OL	OD	INF_D
Mean	11.7889	12.8085	15.3294	22.3571	20.8105
Median	11.5729	13.1927	15.3317	22.3733	15.115
Maximum	17.4752	14.7706	22.3622	26.945	89.0766
Minimum	8.52025	9.52205	11.53	16.4438	-41.434
Std. Dev.	2.1167	1.42511	2.59483	2.7292	21.5054
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Observations	68	68	68	68	68

Source: field survey 2022; analyzed with EViews 12.

A thorough examination of table 3 reveals that none of the pairwise correlations between the independent variables exceeds 0.9, indicating no multicollinearity among the regressors (Daoud, 2017).

Unit root test

The ARDL cointegration estimation requires variables to be cointegrated at I(0) or I(1). Philip–Perron and Augmented Dickey-Fuller tests were used for all variables at levels and first differences. The results are presented in tables 4 and 5.

Table 4. ADF Unit Root Estimation based on trend and intercept

	D_R_	Z_SCORE	OL	OD	INF_D
Mean	11.7889	12.8085	15.3294	22.3571	20.8105
Median	11.5729	13.1927	15.3317	22.3733	15.115
Maximum	17.4752	14.7706	22.3622	26.945	89.0766
Minimum	8.52025	9.52205	11.53	16.4438	-41.434
Std. Dev.	2.1167	1.42511	2.59483	2.7292	21.5054
Skewness	0.53887	-0.8345	0.40634	-0.1868	1.51229
Kurtosis	3.33449	2.71352	2.48025	2.50573	6.52602
Jarque-Bera	3.60801	8.1249	2.63664	1.0875	61.1458
Probability	0.16464	0.01721	0.26759	0.58057	0
Sum	801.642	870.976	1042.4	1520.28	1415.11
Sum Sq. Dev.	300.188	136.073	451.121	499.051	30986.4
Observations	68	68	68	68	68

Source: field survey 2022; analyzed with EViews 12.

The results show that financial stability, financial inclusion, interest rate, and inflation are stationary at the first difference but not at the level (table 4), indicating that all the variables are integrated of order 1.

Table 5. PP Unit Root Estimation based on trend and intercept

Variables	Level		First Difference	
	T Statistic	P Value	T Statistic	P Value
LNZSCORE	-3.4783	0.4878	-3.4794	0.0094
LNOL	-3.4783	0.1038	-3.4794	0.0066
LNOD	-3.4783	0.0377	-3.4794	0.008
LNDR	-3.4783	0.3504	-3.4794	0.0283
LNINFD	-3.4794	0	-3.4805	0

Source: field survey 2022; analyzed with EViews 12.

The results of the Philip–Perron tests in table 5 show that inflation is stationary at order 0, indicating its level of stationarity. In contrast, financial stability, financial inclusion, and interest rates are stationary at order 1, indicating their first-difference stationarity. These findings support the use of the ARDL estimation method, as confirmed by the Philip–Perron (PP) and Augmented Dickey-Fuller (ADF) tests. This study assessed the co-integration of variables using Pesaran, Shin and Smith's (2001) approach following unit root tests. The appropriate lag length, determined using the Hannan-Quinn Criterion, Schwartz Bayesian Criterion (SBC), and Akaike Information Criterion (AIC), is presented in table 6.

Table 6. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	157.157	NA	4.31E-09	-5.0719	-4.8974	-5.0036
1	550.488	707.996	2.01E-14	-17.35	-16.302	-16.94
2	602.114	84.3225	8.44E-15	-18.237	-16.317	-17.486
3	612.87	15.7749	1.42E-14	-17.762	-14.97	-16.67
4	621.252	10.8963	2.70E-14	-17.208	-13.543	-15.775
5	753.635	150.034	8.76E-16	-20.788	-16.25	-19.013
6	815.268	59.5784	3.30E-16	-22.009	-16.599	-19.893
7	852.781	30.0109	3.18E-16	-22.426	-16.143	-19.968
8	918.012	41.31312*	1.50e-16*	-23.76708*	-16.61140*	-20.96810*

Source: field survey 2022; analyzed with EViews 12.

Ardl results

Bounds Test

Table 7. F-Bounds Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	127.169	10%	3.03	4.06
k	4	5%	3.47	4.57
		2.50%	3.89	5.07
		1%	4.4	5.72

Source: field survey 2022; analyzed with EViews 12.

Table 7 shows that the F-static value of 127.1689 exceeds the lower and upper bounds, indicating long-run cointegration between financial inclusion and stability when stability is the dependent variable. Consequently, a quantile regression model can be estimated at these levels. Table 8 provides the Error Correction Model (ECM), or short-run model, to further confirm the long-term relationship.

Table 8. Error Correction Model

Dependent Variable: D(LNZSCORE) Selected Model: ARDL(8, 8, 8, 8, 8) ECM Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-15.2905	0.5351	-28.575	0
@TREND	-0.05985	0.00208	-28.757	0
D(LNZSCORE(-1))	-3.79122	0.1528	-24.811	0
D(LNZSCORE(-2))	-3.77278	0.14347	-26.297	0
D(LNZSCORE(-3))	-3.73469	0.13908	-26.853	0

Table 8. Error...

Dependent Variable: D(LNZSCORE)
Selected Model: ARDL(8, 8, 8, 8, 8)
ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNZSCORE(-4))	-1.41717	0.04046	-35.028	0
D(LNZSCORE(-5))	-1.22872	0.08151	-15.074	0
D(LNZSCORE(-6))	-1.14021	0.073	-15.62	0
+-++D(LNZSCORE(-7))	-1.06234	0.06752	-15.733	0
D(LNOL)	0.249419	0.04017	6.20971	0
D(LNOL(-1))	2.77801	0.09795	28.3622	0
D(LNOL(-2))	2.853596	0.10489	27.2054	0
D(LNOL(-3))	2.91193	0.10819	26.9144	0
D(LNOL(-4))	1.529315	0.06246	24.4838	0
D(LNOL(-5))	1.59672	0.06717	23.7717	0
D(LNOL(-6))	1.64266	0.06839	24.0205	0
D(LNOL(-7))	1.684078	0.06959	24.2002	0
D(LNOD)	-0.70393	0.03524	-19.978	0
D(LNOD(-1))	-4.78586	0.17022	-28.115	0
D(LNOD(-2))	-4.84162	0.17258	-28.055	0
D(LNOD(-3))	-4.89825	0.17574	-27.872	0
D(LNOD(-4))	-2.45459	0.09623	-25.507	0
D(LNOD(-5))	-2.47608	0.0876	-28.266	0
D(LNOD(-6))	-2.50395	0.09111	-27.482	0
D(LNOD(-7))	-2.55957	0.09445	-27.1	0
D(LNINFD)	-0.51316	0.01838	-27.922	0
D(LNINFD(-1))	0.429901	0.01557	27.6091	0
D(LNINFD(-2))	0.419701	0.01538	27.2961	0
D(LNINFD(-3))	0.413438	0.01532	26.9873	0
D(LNINFD(-4))	0.017625	0.00743	2.37379	0.0325
D(LNINFD(-5))	0.003447	0.00754	0.45702	0.6547

Table 8. Error…

Dependent Variable: D(LNZSCORE)
Selected Model: ARDL(8, 8, 8, 8, 8)
ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINFD(-6))	-0.00394	0.00734	-0.5364	0.6001
D(LNINFD(-7))	-0.01116	0.0065	-1.7181	0.1078
D(LNDR)	1.611059	0.06726	23.9534	0
D(LNDR(-1))	-1.27612	0.05346	-23.87	0
D(LNDR(-2))	-1.26206	0.05179	-24.37	0
D(LNDR(-3))	-1.25022	0.05136	-24.34	0
D(LNDR(-4))	-0.22192	0.0169	-13.13	0
D(LNDR(-5))	-0.19538	0.01455	-13.432	0
D(LNDR(-6))	-0.18437	0.01494	-12.34	0
D(LNDR(-7))	-0.18986	0.014	-13.562	0
CointEq(-1)*	2.843136	0.09944	28.5922	0
R-squared	0.998072	Mean dependent var.		0.00162
Adjusted R-squared	0.993681	S.D. dependent var.		0.02945
S.E. of regression	0.002341	Akaike info criterion.		-9.0805
Sum squared resid	9.86E-05	Schwarz criterion.		-7.6145
Log likelihood	314.4147	Hannan-Quinn criter.		-8.507
F-statistic	227.2781	Durbin-Watson stat.		2.02629
Prob(F-statistic)	0			

Source: field survey 2022; analyzed with EViews 12.

Table 8 illustrates the expected negative sign of the error-correction term lagged by one period (ECTt-1) at the 1% significance level. ECT, with a coefficient of 2.843136, indicates the adjustment rate required to restore stability after disruption. This substantial ECT suggests that following a short-run shock, approximately 2.84% of the deviation from the long-run equilibrium is corrected for each quarter. Thus, when variables are shocked, they stabilize over time, with higher absolute ECT, reinforcing evidence for long-term relationships.

Diagnostics of ARDL

The functional form specification (Ramsey Reset Test), heteroskedasticity, model stability, and serial correlation LM tests are among these diagnostic tests. The p-values (0.112) and F-statistic (0.0718) of the BGLM test were greater than 0.05, respectively (Appendix A). Consequently, the study concludes that the model has no serial correlation, and thereby accepts the null hypothesis that there is no serial correlation. This ensured the dependability of the model. Furthermore, the p-value of the heteroskedasticity test in Appendix A was 0.8624, exceeding 0.05, thus accepting the null hypothesis of no heteroskedasticity and indicating the model's reliability. The CUSUM plot in Appendix B shows the CUSUM line within the 5% bound for ARDL, thus confirming the long-term connection between financial stability and inclusion.

Table 9. Quantile Process Estimates

Quantile Process Estimates
Specification: LOG(LNZSCORE) LNOL LNOD LNINFD LNDR C

	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
LNOL	0.1	-0.2939	0.03284	-8.9499	0
	0.2	-0.2556	0.03203	-7.9787	0
	0.3	-0.2411	0.04106	-5.8711	0
	0.4	-0.2438	0.04644	-5.2504	0
	0.5	-0.1769	0.05439	-3.2518	0.0018
	0.6	-0.1185	0.03267	-3.6286	0.0006
	0.7	-0.1374	0.0366	-3.7549	0.0004
	0.8	-0.1423	0.0369	-3.8559	0.0003
	0.9	-0.1393	0.03119	-4.4667	0
LNOD	0.1	-0.0112	0.0884	-0.1264	0.8998
	0.2	0.03203	0.06761	0.47381	0.6373
	0.3	0.05098	0.07509	0.67899	0.4996
	0.4	0.03495	0.0806	0.43369	0.666
	0.5	0.08518	0.06493	1.312	0.1943

Table 9. Quantile...

Quantile Process Estimates
Specification: LOG(LNZSCORE) LNOL LNOD LNINFD LNDR C

	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
	0.6	0.12181	0.04846	2.51364	0.0145
	0.7	0.13323	0.05511	2.41736	0.0185
	0.8	0.16134	0.05179	3.11506	0.0028
	0.9	0.18235	0.04492	4.05972	0.0001
LNINFD	0.1	0.00886	0.0187	0.47396	0.6372
	0.2	0.00581	0.0121	0.48046	0.6326
	0.3	0.00964	0.01276	0.75556	0.4527
	0.4	0.00488	0.0134	0.3639	0.7172
	0.5	0.01873	0.01153	1.62439	0.1093
	0.6	0.02271	0.0099	2.29321	0.0252
	0.7	0.01966	0.0094	2.09139	0.0405
	0.8	0.02828	0.00778	3.63354	0.0006
	0.9	0.03157	0.00661	4.77709	0
LNDR	0.1	0.05821	0.0416	1.39931	0.1666
	0.2	0.014	0.02661	0.5262	0.6006
	0.3	0.01049	0.03022	0.34717	0.7296
	0.4	0.0118	0.03414	0.34561	0.7308
	0.5	0.05685	0.04077	1.39441	0.1681
	0.6	0.08702	0.03615	2.40717	0.019
	0.7	0.08889	0.03607	2.46454	0.0165
	0.8	0.0931	0.03382	2.75277	0.0077
	0.9	0.0876	0.03037	2.88422	0.0054
C	0.1	1.56165	0.34808	4.48649	0
	0.2	1.45126	0.26742	5.42692	0
	0.3	1.3569	0.30472	4.45289	0
	0.4	1.42826	0.32547	4.38831	0

Table 9. Quantile…

Quantile Process Estimates
Specification: LOG(LNZSCORE) LNOL LNOD LNINFD LNDR C

	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
	0.5	0.95829	0.33509	2.8598	0.0057
	0.6	0.61539	0.24752	2.48622	0.0156
	0.7	0.64106	0.23802	2.69327	0.0091
	0.8	0.53784	0.20521	2.62089	0.011
	0.9	0.47233	0.17618	2.68098	0.0094

Source: field survey 2022; analyzed with EViews 12.

The results of the long-run regression analysis demonstrate a significant positive impact of financial inclusion on financial stability, especially at higher quantile levels. For instance, LNOL showed a significant effect from quantile 5 upward, and LNOD, LNDR, and LNINFD all showed significant effects from quantile 6 upward. This indicates that financial inclusion has a stronger stabilizing effect on economic actors in the upper quantiles, and fosters stability over time. This suggests that the financial inclusion mechanism becomes influential as financial engagement increases among the people. Thus, the financial sector can benefit significantly from expanding accessibility, which enhances inclusion at all levels of financial engagement in Ghana. These results correspond with findings from broader sub-Saharan Africa, where financial inclusion tends to have a more pronounced impact on economic stability in economies with higher financial penetration (Djoufouet & Pondie, 2022). For instance, studies in Nigeria show that financial inclusion significantly enhances financial stability, particularly through mobile banking and fintech adoption, which offer more accessibility and inclusion for financial engagement (Olusegun et al., 2021; Anthony-Orji et al., 2021). This strongly mirrors Ghana's trend toward stronger effects at higher quantiles, as the results indicate. Similarly, research across West Africa suggests that financial inclusion fosters economic resilience at increasing quantile levels (Babatunde, 2024; Camara & Diallo, 2020), However, country-level disparities in access, especially in rural areas, can limit its effectiveness. Notwithstanding, since most sub-Saharan African countries exhibit similar economic characteristics (World Bank, 2021), the results suggest that, as the financial system in Ghana and these countries becomes more inclusive, it will also become more stable, particularly at higher quantiles. Comparatively, international studies have indicated that the impact of financial inclusion varies by region. In developed economies, financial inclusion stabilizes markets through diversified financial instruments (Danisman & Tarazi, 2020), whereas in sub-Saharan Africa, its role is more fundamental, providing basic financial access and reducing economic volatility (Moeti & Sin Yu, 2024; Kamara, 2024). The findings of this study therefore reinforce the argument that higher levels of financial inclusion amplify stability, particularly in emerging economies (Antwi et al., 2024). However, regional disparities in infrastructure and policy frameworks can influence the extent of this relationship. Hence, strengthening financial literacy and digital banking that enhance inclusion could further enhance stability, particularly in the sub-Saharan African region. The study results generally suggest that at the international, regional, or national level, when examining the relationship between financial inclusion and stability, especially policy actions, it is crucial to consider varying quantile levels rather than relying solely on the average effects, as this can provide valuable insights for policymaking and financial evaluation.

Conclusion and policy implications

This study uses a quantile regression approach to assess the impact of financial inclusion on Ghanaian financial stability. Secondary data from the World Bank, IMF, and Bank of Ghana (2005–2021) were analyzed. The stationarity of the data was verified using the ADF and PP tests. The ADRL bound test for cointegration reveals a significant long-term relationship between the variables, indicating that the independent variables explain financial stability. A long-run regression analysis demonstrates the positive impact of financial inclusion on financial stability, especially at higher quantile levels.

The findings of this study have significant policy implications for Ghana, West Africa, and the broader sub-Saharan African region, particularly concerning financial inclusion and economic stability. In Ghana, the noticeable impact of financial inclusion at higher quantile levels indicates that policies should aim to enhance financial access for lower-income and underserved populations. While financial inclusion bolsters stability at higher quantiles, policymakers must address disparities in banking accessibility, digital financial literacy, and regulatory support for fintech innovations at individual, firm, and household levels. Strengthening mobile banking frameworks, expanding microfinance institutions, and ensuring robust consumer protection laws can help lower quantiles benefit equally from financial inclusion (World Bank, 2021). Furthermore, targeted interventions for women, rural populations, and informal sector workers are crucial for bridging the financial gaps and maximizing inclusion-driven stability. These interventions should address different segments of the financial system where the impact of financial inclusion on stability is most significant. A similar policy focus is necessary across West and sub-Saharan Africa. Countries such as Nigeria, Kenya, and South Africa have witnessed how financial inclusion can bolster macroeconomic resilience; however, disparities and access to formal banking persist. To reinforce economic stability, regional governments should collaborate on harmonized digital financial policies, cross-border fintech regulations, and mobile money interoperability. Additionally, aligning financial inclusion with monetary policies, such as interest rate stabilization and inflation control, can further enhance financial security. Policymakers should start to leverage AI-driven financial tools to improve credit accessibility and risk management, particularly for SMEs (Djoufouet & Pondie, 2022; Olusegun et al., 2021). Finally, a financial inclusion strategy that incorporates best practices among the economies in each regional block would also facilitate sustainable and inclusive economic growth.

Future research should explore the mechanisms underlying the increased impact of financial inclusion in higher quantiles and its applicability in different economic contexts. Understanding these quantile-specific relationships can help to develop nuanced strategies to promote financial inclusion and stability in Ghana and other developing economies.

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Appendix (A)

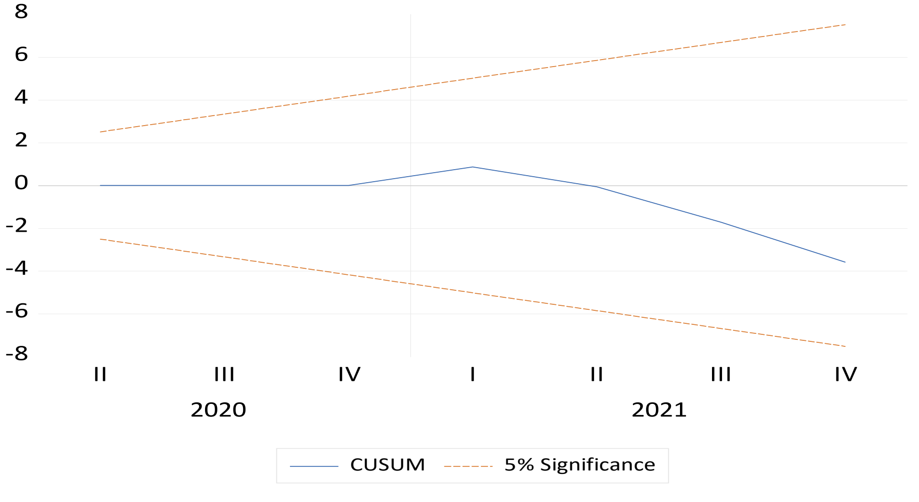
Heteroskedasticity and Serial Correlation

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	0.61412	Prob. F(45,14)	0.86249
Obs*R-squared	37.4116	Prob. Chi-Square(45)	0.7261
Scaled explained SS	1.64211	Prob. Chi-Square(45)	1
Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 8 lags			
F-statistic	223.917	Prob. F(8,6)	0.112
Obs*R-squared	59.7997	Prob. Chi-Square(8)	0.0718

Source: field survey 2022.

Appendix (B)

The CUSUM plot of long-term relationship



Source: field survey 2022.