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The heterogeneous effects of macroeconomic and financial factors on financial deepening in Africa: evidence from a method of moments quantile regression analysis

Bahati Sanga and Meshach Aziakpono
Faculty of Economic and Management Sciences, Stellenbosch University, Stellenbosch, South Africa

Abstract

Purpose – This paper aims to investigate the heterogeneous effects of macroeconomic and financial factors across various distributions of financial deepening in 22 African countries over the past two decades (2000–2019).

Design/methodology/approach – The paper uses a recent method of moments quantile regression, which accounts for the often overlooked heterogeneity effects. The analysis focuses on the banking sector, which is predominant in Africa, using a broad range of macroeconomic and financial indicators.

Findings – The findings show that gross domestic product per capita positively and significantly impacts financing deepening with an increasing marginal benefit as depth increases. Trade openness positively and substantially affects only high financial deepening. Real interest rate, real exchange rate and inflations negatively and significantly affect financial deepening, especially at higher than lower levels. Financial stability positively and substantially influences financial deepening with an increasing marginal benefit as the depth increases. Bank lending interest rate, bank lending–deposit rate spread, bank concentration and return on equity negatively and substantially impact higher levels of financial deepening than lower levels.

Practical implications – These findings are crucial to policymakers and development partners, as promoting a favourable financial environment and stable macroeconomic policies based on the heterogeneity of financial depths can increase debt financing in Africa.

Originality/value – To the best of the authors' knowledge, this paper is one of the first attempts to analyse the heterogeneous effects of macroeconomic and financial determinants on varying levels of financial depth in Africa.

Keywords Bank credit, Macroeconomic factors, Financial factors, Debt financing, Africa, Bank credit

Paper type Research paper

JEL classification – G21, P26, P48, O43, O55

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1. Introduction

Financial deepening, the central topic in this paper, refers to expanding the range of financial services and products available to all segments of society, enabling them to undertake economic activities. The seminal studies of Shaw (1973) and McKinnon (1973) favour financial deepening and openness as opposed to financial repression. This is because financial deepening and openness increase savings that can be intermediated to investments. Financial deepening, along with financial stability, financial efficiency and financial access, are the four dimensions of financial development (Čihák *et al.*, 2012). However, the latter three dimensions contribute to financial deepening, as demonstrated in this paper.

The empirical evidence suggests that financial deepening allows all firms of different sizes to access financial services and alleviates their financing (Beck, 2013; Beck *et al.*, 2005, 2008). King and Levine (1993) argue that a well-developed financial market fosters entrepreneurship activities and innovation through financial intermediaries channelling savings to the most productive investments. Demirgüç-Kunt and Levine (2009) emphasise that financial deepening increases access to the credit markets and growth opportunities for small businesses. Dutta and Meierrieks (2021) posit that a high level of financial market development increases entrepreneurship activities, while Cao-Alvira and Palacios-Chacón (2021) show a strong positive relationship between financial deepening and business creation. Thus, financial deepening provides entrepreneurs and small businesses access to capital and financial services. It is, therefore, imperative to explore which macroeconomic and financial factors play a crucial role in increasing financial deepening to invigorate bank debt financing in Africa. The institutional and technological determinants of financial deepening are discussed in previous papers (Sanga and Aziakpono, 2022, 2023).

While there is a substantial and growing literature on macroeconomic and financial determinants of financial development (Aluko and Ajayi, 2018; Baoko *et al.*, 2017; Čihák *et al.*, 2012; Djankov *et al.*, 2007; Imran and Nishat, 2013; King and Levine, 1993; Levine, 2005), the existing empirical literature primarily used standard linear regression methods, assuming a constant effect of determinants across different levels of financial development. This approach overlooks the potential heterogeneity in the impacts of these factors. The diagnostic analysis and descriptive statistics discussed later in this paper confirm that the data set for financial deepening is not homogenous among African countries or over time within a country. In addition, the data set is not normally distributed, with financial depth ranging from a minimum of 1.5% to a maximum of 106.3%. In the presence of heterogeneity, assuming a constant effect of the macroeconomic and financial factors will lead to misleading policy proposals since different levels of financial depth will require various interventions to stimulate financial deepening. We adopt a novel approach to explain the heterogeneity of financial deepening. To our knowledge, this paper is the first to analyse the heterogeneous effects of macroeconomic and financial determinants on varying levels of financial depth in Africa, thereby addressing this gap in the literature.

Against this background, the paper seeks to achieve the following:

- examines one specific dimension of financial development, that is, financial deepening. This is because financial deepening explains the depth of resource allocation to firms of different sizes. Furthermore, unlike previous papers that constructed an index of financial development using the four dimensions, this paper demonstrates that the other three dimensions influence financial deepening significantly;
- uses extensive financial and macroeconomic indicators and analyses their effects on financial deepening in Africa. The macroeconomic factors examined in this paper are economic development, inflation, trade openness, real interest rate and real exchange rate. The financial factors analysed in this paper are bank lending interest rate, lending–deposit rate spread, return on equity, concentration and stability;

- focuses on the banking sector, which dominates the financial system in Africa;
- uses a recent method of moments quantile regression (MMQR) by Machado and Santos Silva (2019), which offers a unique perspective on the relationship between the dependent and explanatory variables, managing endogenous explanatory variables and uncovering disregarded heterogeneous covariance effects in panel data models; and
- underscores the importance of enhancing macroeconomic stability and improving the financial environment to increase financial deepening but also challenges the notion of the underlying uniform effect across different financial depths, as suggested by previous studies.

The remainder of this paper is structured as follows: Section 2 discusses the theoretical considerations. Section 3 reviews the empirical literature, highlighting the existing knowledge gaps our study aims to fill. Section 4 discusses the methodology used. Section 5 delves into the results and discussion. Finally, Section 6 discusses the policy implications and conclusions.

2. Underpinning theories

As discussed in subsequent sections, different theories articulate the relationship between financial and macroeconomic factors and financial deepening.

2.1 Macroeconomic factors

2.1.1 Economic development. The finance–growth nexus theory (Levine, 2005) demonstrates the relationship between financial development and economic growth, whereby financial development influences economic growth through:

- the production of investment information and efficient allocation of capital to productive activities;
- supervision of investments and exertion of good corporate governance;
- promotion of trade, and exchange of goods and services;
- improved resource mobilisation and allocation; and
- enhancement of management of risk and diversification.

In the finance–growth reverse relationship, vibrant economic growth creates a favourable business environment and opportunities, consequently increasing the demand for credit by the private sector (Baoko *et al.*, 2017; Boyd *et al.*, 2001; Imran and Nishat, 2013). Similarly, high economic development is associated with increased economic activities which require credit supply (Nguyen *et al.*, 2018). Economic growth:

- increases the average earning of the population, which can lead to a rise in bank deposits;
- increases demand for goods and services in all sectors, which increases demand for credit for investment; and
- enhances the growth of financial institutions and markets.

All these are demonstrated by the fact that most high-income countries, which serve as an indicator of economic development, tend to have well-developed financial markets.

Therefore, economic development is expected to impact Africa's financial deepening positively.

2.1.2 Inflation. The inflation–finance theory (Huybens and Smith, 1999) states that high inflation as an indicator of macroeconomic instability has a negative effect on finance due to the devaluing of outstanding portfolios, interest rate effects and reduction of return on equity, consequently resulting in credit rationing (Boadi, 2016; Ghosh, 2018; Imran and Nishat, 2013). Conversely, competing inflation-finance theory argues that the relationship between inflation and finance is non-linear depending on the inflation threshold (Boyd *et al.*, 2001). For example, some studies found inflation and finance to have positive relationships in the short run (Baoko *et al.*, 2017; Enisan and Oluwafemi, 2015) but negative in the long run. High inflation reduces financial intermediation and lending activities (Chinn and Ito, 2006; Huybens and Smith, 1999). This is because high inflation erodes the confidence of lenders and investors to engage in long-term investments due to uncertainties. High inflation also increases the cost of information and transactions. All these reduce the demand and supply of credit. Therefore, we expect high inflation to be detrimental to Africa's financial deepening.

2.1.3 Trade openness. The trade openness–finance theory suggests that the positive effect of trade openness on economic growth creates demand for credit and consequently spurs financial development (Kim *et al.*, 2010; Nguyen *et al.*, 2018). Trade openness allows the free movement of goods and services, and increases the volume of transactions and logistics, which enhances financial intermediation. Chinn and Ito (2006) argue that trade openness should proceed with financial openness, and the existence of both positively influences financial development. However, trade openness negatively affects repressed financial markets or countries that do not have expert-led strategies and high economic growth (Andrianaivo and Yartey, 2010; Huang and Temple, 2005; Nguyen *et al.*, 2018). This paper expects trade openness to affect financial deepening in Africa either positively or negatively.

2.1.4 Real interest rate. An increase in the real interest rate increases the cost of funds to the banking sector, consequently reducing the supply of bank credits. A high interest rate increases the lending interest rate spread and consequently discourages demand for bank credit in an economy (Silva and Pirtouscheg, 2015). Volatility in interest rates increases the banking spread, which, in turn, suppresses financial intermediation (Maudos and Guevara, 2004). In general, high real interest rates reduce deposits and loans, as it increases bank lending–deposit spread. Thus, high and volatile interest rates may negatively impact financial deepening in Africa.

2.1.5 Real exchange rate. The classical trade theory emphasises that the real exchange rate significantly affects cross-border trade and capital flows, whereby devaluation of domestic currency improves trade balance while its appreciation impedes exports. Kodongo and Ojah (2013) support this classical view in Africa following their findings that the trade balance improves when the domestic currency depreciates. If stable, the real exchange rate enables banks to allocate credit to enterprises (Imran and Nishat, 2013). Thus, a decrease in the real exchange rate increases trade volumes, which sparks demand for bank credit and vice versa. This study expects the real exchange rate to adversely affect financial deepening in Africa due to volatility.

2.2 Financial factors

2.2.1 Bank profitability (efficiency). The theoretical literature explains bank efficiency in three dimensions (Aluko and Ibrahim, 2020): First, bank efficiency in terms of profitability is measured by return on assets or return on equity. High profitability in terms of return on

assets or equity may be characterised by high lending interest rates and banking spread, thus reducing deposits and credit (Beck and Demirgüç-Kunt, 2006). In this dimension, there is a non-linear relationship between bank efficiency and bank credit. Second, bank efficiency in terms of intermediation is measured by the bank credit-to-deposit ratio. High bank efficiency reduces the cost of borrowing and, consequently, promotes access to credit (Osei-Tutu and Weill, 2022; Shamshur and Weill, 2019). Third, bank efficiency in terms of operational efficiency is measured by non-interest income to total income. High bank efficiency reduces borrowing costs, stimulating lending activities. In the last two dimensions, the relationship between bank efficiency and bank credit is linear. This study uses return on equity as a proxy of bank efficiency in terms of profitability and expects them to negatively affect financial deepening in Africa.

2.2.2 Bank lending interest rates and bank lending–deposit rate spread. Low lending interest rates and spreads increase financial intermediation, which promotes debt financing (Adeleye, 2021). The low cost of borrowing motivates small and medium-sized enterprises (SMEs) and entrepreneurs to seek bank credit to finance their businesses (Beck, 2013). However, high bank lending interest rates and spread reduce deposits and credits, which can be due to a non-competitive market structure stemming from bank concentration. High lending interest rates and bank lending–deposit spread are considered detrimental to bank credit because of the high cost of credit (Shamshur and Weill, 2019; Sharma and Gounder, 2012). Thus, high lending interest rates and spreads reduce demand for bank credit, negatively impacting financial deepening.

2.2.3 Bank concentration. There are two competing theories on the relationship between bank concentration and bank credit: the degree of bank competition may either positively or negatively impact bank financing (Berger and Udell, 2006; Leon, 2015; Lu *et al.*, 2020; Ryan *et al.*, 2014). The market power theory posits that an increased bank market power impels limited competition in the banking sector due to high concentration, high lending interest rates and limited credit supply (Boot, 2000; Klein, 1971; Ryan *et al.*, 2014). Bank concentration may reduce access to bank credit and increase the cost of credit because of monopoly and information hold (Boot, 2000). In contrast, information theory postulates that limited competition enables banks to collect information and build relationships with borrowers, thereby reducing information asymmetry and associated costs and, hence, increasing access to credit (Berger and Udell, 2006; Petersen and Rajan, 1995; Ryan *et al.*, 2014). Using the five banks concentration ratio (CR5), this study presumes a negative effect on financial deepening in Africa because of the non-competitive market structure, which is characterised by high bank lending interest rates and banking spread.

2.2.4 Bank stability. Non-performing loans and the Z-score of banks are proxies of risk in the banking sector, which may affect bank credit to the private sector (Ghosh, 2018). The banking crisis leads to restricted credit access (Assaf *et al.*, 2019; Fratzscher *et al.*, 2016). However, stable banking conditions increase confidence and the ability of lenders to issue long-term loans for investment because of market certainty. Furthermore, stable banking conditions increase deposits from savers, consequently increasing bank liquidity and loans for investment. We expect a positive and linear relationship between bank stability and financial deepening in Africa.

3. Empirical literature review

The empirical studies examining the impact of macroeconomic and financial factors on financial development using credit to the private sector by banks as a percentage of gross domestic product (GDP), which is also an indicator for financial deepening, relate to our research.

The first strand of literature focuses on macroeconomic determinants for financial development. Djankov *et al.* (2007) examined the factors that impact private credit in 129 countries from 1978 to 2003, using ordinary least squares (OLS) regressions. The authors demonstrated that economic development significantly and positively impacts bank credit to the private sector. They also found that inflation negatively and substantially impacts all poor and rich countries. Similar findings on the effect of economic development and inflation on bank credit to the private sector were obtained by Andrianaivo and Yartey (2010) in 53 African countries from 1990 to 2006; Ibrahim and Sare (2018) in 46 African countries for the period 1980–2015; Aluko and Ibrahim (2020) in 32 SSA countries for the period 1985–2015. These studies used the system generalized method of moments (GMM) for analysis. However, there are other empirical studies in Africa with contrasting results. For example, Allen *et al.* (2014) found that GDP per capita had a positive and significant influence, but inflation was negative and insignificant on financial development in 37 SSA countries for the period of 2007–2011 using OLS regression. Using the autoregressive distributed lag (ARDL) on time series data from 1970 to 2011 in Ghana, Baoko *et al.* (2017) found inflation positively influenced bank credit in the short run, while economic growth had an insignificant impact. Aluko and Ajayi (2018) found that GDP per capita and inflation had a positive effect, but both had a negligible impact on bank credit in 25 SSA countries for the period of 1997–2014 using GMM.

Kim *et al.* (2010) demonstrated that trade openness positively affects financial development after analysing 88 countries (including 25 African countries) for the period of 1960–2005. Other studies that have shown evidence of a positive and significant effect of trade openness on financial deepening include Andrianaivo and Yartey (2010) in 53 African countries; Ibrahim and Sare (2018) in 46 African countries; Aluko and Ajayi (2018) in 25 SSA countries; and Aluko and Ibrahim (2020) in 32 SSA countries. In contrast, other studies have opposing results: Ahmed (2013) demonstrated that trade openness alone negatively and significantly affects financial deepening in 21 SSA countries from 1981 to 2009, using the system GMM. Nguyen *et al.* (2018) showed that trade openness significantly and negatively impacts domestic credit after analysing 33 emerging countries (including three African countries) from 2002 to 2015, also using the system GMM. Shokr (2020) found that real interest rates had a significant and negative effect on bank loans in Egypt when the GMM technique was applied to panel data during the period of 1996–2014. Modugu and Dempere (2022) reported similar results: an increase in monetary policy rates reduced bank lending in 20 SSA countries from 2010 to 2019 using the system GMM.

However, Le Roux *et al.* (2017) showed that real interest rates had an insignificant impact on bank lending in 15 SADC countries from 1985 to 2014 using panel dynamic fixed and random effects. Using fixed effects regression, Guo and Stepanyan (2011) demonstrated a positive and significant impact of stable exchange rates on bank credit in 38 countries from 2001 to 2010. Imran and Nishat (2013) obtained similar results in Pakistan for 1971–2010 using ARDL. Kodongo and Ojah (2013) found that the trade balance improves when the domestic currency depreciates in 9 African countries from 1993 to 2009, while Baoko *et al.* (2017) found that the real exchange rate has an insignificant impact on bank lending in Ghana.

The second strand of literature delves into financial determinants for financial development. Bank lending interest rate and bank lending–deposit rate spread were found to have a significant impact and non-linear relationship with credit to the private sector by banks (Assefa, 2014; Baoko *et al.*, 2017; Enisan and Oluwafemi, 2015; Sharma and Gounder, 2012; Shijaku and Kalluci, 2013). Asongu *et al.* (2021) established that return on equity significantly and positively impacts the growth of the informal financial sector after analysing 48 SSA countries from 1995 to 2017 using OLS and quantile regression. The bank concentration was

found to constrain financial development in 15 SADC countries (Le Roux *et al.*, 2017) in line with market power theory. In contrast, Asongu *et al.* (2021) found that bank concentration did not affect informal financial sector development in Africa. Furthermore, Ayalew and Xianzhi (2019) revealed that competition (a result of bank concentration, among others) negatively and significantly alleviated credit constraints in 27 African countries from 2013 to 2016. The information theory discussed in Section 2.2.3 supports their findings. Moyo and Sibindi (2022) had similar conclusions using the Lerner Index and the five-bank concentration ratio in 14 SSA countries for the period 2016–2019. However, when using the Boone indicator, the authors showed different results that align with the market power theory discussed in Section 2.2.3. Asongu *et al.* (2021) found that financial stability negatively and significantly affected informal financial sector development in Africa.

Various salient points emerge from the reviewed literature. First, it has mixed and inconclusive results, particularly in Africa. Second, very few studies focus on one specific dimension of financial development, namely financial deepening. The previous studies use principal component analysis (PCA) to construct a financial development index using four variables: financial deepening, stability, efficiency and access. However, financial access, efficiency and stability may significantly impact financial deepening. We, therefore, use the other three dimensions as explanatory and control variables for financial deepening. Third, the reviewed empirical studies have employed limited independent variables to examine the determinants of financial development. We, therefore, use a broader range of macroeconomic and financial indicators. Finally, to the best of our knowledge, no previous study has analysed the heterogeneous effects of macroeconomic and financial determinants on different levels of financial depth in Africa.

4. Methodology

4.1 Data

The study uses panel data from the World Bank's development and governance indicators to examine the heterogeneous effect of macroeconomic and financial factors on financial deepening in 22 African countries from 2000 to 2019. These countries were selected because of the availability of complete data during the research period (see Table 2).

Financial deepening (FD_{it}) is the primary dependent variable for this study. It is commonly measured by either the size of the stock market as a percentage of GDP or bank credit to the private sector as a percentage of GDP (McKinnon, 1973; Shaw, 1973). The former is relevant in developed countries with well-established capital markets, while the latter is used in developing countries where the banking sector is prevalent. The macroeconomic explanatory variables analysed in this paper are economic development ($GDPPC_{it}$), inflation (INF_{it}), trade openness ($TRADE_{it}$), real interest rate (RIR_{it}) and real exchange rate (RER_{it}). The financial explanatory variables analysed in this paper are bank lending interest rate (LIR_{it}), bank lending–deposit rate spread ($SPREAD_{it}$), return on equity (ROA_{it}), bank concentration ($CONC_{it}$) and bank stability ($ZSCORE_{it}$). All these variables and their priori expectations are discussed in Section 2. Finally, the study will employ the following three essential control variables which matter most for financial deepening in Africa compared to other regions (Allen *et al.*, 2014; Aluko and Ajayi, 2018; Sanga and Aziakpono, 2022, 2023): population density ($POPD_{it}$), institutional quality ($INST_{it}$) and mobile phone subscriptions (MOB_{it}).

4.2 Model and estimation method

To examine the potential influence of macroeconomic and financial factors on financial deepening, this study uses the model by Djankov *et al.* (2007):

$$FD_{it} = \beta_0 + \beta_1 ECON_{it} + \beta_2 FIN_{it} + \beta_3 CO_{it} + \mu_{it} \quad (1)$$

Whereby $ECON_{it}$ and FIN_{it} represent vectors of macroeconomic ($GDPPC_{it}$, $TRADE_{it}$, INF_{it}, RIR_{it} and RER_{it}) and financial factors (LIR_{it}, $SPREAD_{it}$, ROE_{it}, $CONC_{it}$ and $ZSCORE_{it}$) that impact financial deepening (FD_{it}); CO_{it} is the control variables vector ($POPD_{it}$, MOB_{it} and $INST_{it}$); β and μ_{it} are parameters and error vectors.

Previous studies discussed in Section 3 used the standard mean regressions, which do not explain the heterogeneity of the relationships. This paper takes advantage of the recent MMQR introduced by Machado and Santos Silva (2019). MMQR provides a deep understanding of the relationship between the dependent and independent variables by managing endogenous explanatory variables and recognising disregarded heterogeneous covariance effects. Furthermore, MMQR addresses outliers of FD_{it} by quantifying changes across its distribution using conditional medians measured in quantile differences (p quantile). This paper uses the same MMQR approach as discussed in our previous study (Sanga and Aziakpono, 2024), which investigated the impact of FinTech development on entrepreneurship and SME financing.

The MMQR model is adopted to estimate the conditional quantiles $Q_Y(p|X_{it})$ by combining estimates of the location and scale functions [1] (Machado and Santos Silva, 2019):

$$Y_{it} = \alpha_i + X_{it}^{'}\beta + \left(\delta_i + Z_{it}^{'}\gamma\right) U_{it}. \quad (2)$$

Where $P\{\delta_i + Z_{it}^{'}\gamma > 0\} = 1$ is the probability. The parameters to be estimated are defined as $(\alpha, \beta', \delta, \gamma)'$. The discrete i fixed effects are defined as (α_i, δ_i), $i = 1, \ldots, n$. Z describes the k-vector of recognised components of X, which are distinct transformations with j specified by: $Z_j = Z_j(X)$ $j = 1, 2, \ldots, k$. X_{it} and U_{it} are autonomously and evenly distributed across individuals i, through time t, and are orthogonal to X_{it}. This satisfies the moment criteria in Machado and Santos Silva (2019). Thus, equation (2) implies the following:

$$Q_Y(p|X_{it}) = (\alpha_i + \delta_i q(p)) + X_{it}^{'}\beta + Z_{it}^{'}\gamma q(p) \quad (3)$$

Where X_{it} contains all explanatory variables ($GDPPC_{it}$, $TRADE_{it}$, INF_{it}, RIR_{it}, RER_{it}, LIR_{it}, $SPREAD_{it}$, ROE_{it}, $CONC_{it}$, $ZSCORE_{it}$) and control variables ($POPD_{it}$, MOB_{it} and $INST_{it}$). $Q_Y(p|X_{it})$ is the quantile distribution of the dependent variable Y_{it}, which in this study is FD_{it} conditional on location of explanatory variable X_{it}. $\alpha_i + \delta_i q(p)$ is the scale coefficient showing the p quantile fixed effects across individual i. Finally, $q(p)$ is pth quantile estimated through resolving the subsequent optimisation problem as:

$$Minimise_q \sum_i \sum_t \rho_p \left(R_{it} - Z_{it}^{'}\gamma q(p)\right) \quad (4)$$

Where $\rho_p(A) = (p-1)AI\{A \leq 0\} + TAI\{A > 0\}$ indicates a check function.

We also usw a 2SLS (Anderson and Hsiao, 1982), which addresses the endogeneity, to compare MMQR results of location parameters and the 50th percentile with previous empirical studies that used standard mean regression methods.

5. Results

5.1 Descriptive statistics and diagnostic analysis

The descriptive statistics results are presented in Table 1. Our primary dependent variable, financial deepening, has an uneven distribution with a minimum of 1.5% and a maximum of

106.3%. In our data set of 22 countries, only Mauritius, Namibia and South Africa have bank credit to the private sector of over 50%. Furthermore, Gambia, Madagascar, Malawi, Tanzania, Sierra Leone, Uganda and Zambia have bank credit to the private sector below 15%. The remaining 12 countries in our data set have bank credit between 15% and 50%.

Table 2 shows the countries analysed in this paper and the comparison of financial intermediation for the two past decades: 2000–2009 and 2010–2019. Except for Egypt, the remaining 21 countries showed an increased trend in bank deposits as a percentage of GDP and bank credit to the private sector as a percentage of GDP. Meanwhile, between the two decades, Burundi, Egypt, Gambia, Mauritania, Namibia and South Africa showed a declining trend in bank credit-to-deposit ratios. Finally, the bank lending–deposit rate spread has declined over the past two decades, except for Algeria, Gambia, Madagascar, Malawi, Nigeria and Rwanda.

Furthermore, the correlation matrices (Appendix Table A1 and A2) show that GDP per capita and institutional quality highly correlate with bank credit to the private sector. In addition, real exchange rates, mobile phone subscriptions and institutional quality highly correlate with GDP per capita. Thus, individual regressions were run for each variable to account for its impact on bank credit. Finally, Table 3 indicates results from diagnostic analysis and confirms the presence of heteroscedasticity and random effect. Therefore, we use MMQR with fixed effects (see Section 4.2), which handles the panel with data that is not homogenous, not normally distributed and endogeneity.

5.2 Econometric results and discussion

5.2.1 The effect of macroeconomic factors on financial deepening. Tables 4 and 5 show the MMQR and 2SLS results of the impact of macroeconomic determinants on financial

Variable	Definition/Measure	Obs	Mean	SD	Min	Max
FD_{it}	Bank credit to the private sector (% of GDP)	440	22.5	20.4	1.5	106.3
$GDPPC_{it}$	Log of GDP per capita (constant 2010 US$)	440	7.3	1.1	5.3	9.3
$TRADE_{it}$	Total trade as % of GDP (imports and exports)	440	73.9	34.4	21.1	225.2
RIR_{it}	Real interest rate. The lending interest rate adjusted for inflation as measured by the GDP deflator (%)	440	9.1	11.2	−60.8	52.4
RER_{it}	Real exchange rate. The nominal exchange rate and the ratio of prices between the two countries	440	595.9	1170.3	3.1	9010.2
INF_{it}	Inflation consumer prices (annual %)	440	9.5	16.1	−3.7	268.4
$ZSCORE_{it}$	The probability of default of a country's commercial banking system (financial stability)	440	14.8	6.9	2.6	49.1
LIR_{it}	Bank lending interest rate (%)	440	19.5	12.9	6.4	103.2
$SPREAD_{it}$	Difference between the bank lending rate and the deposit rate	440	10.9	9.3	0.5	69.9
$CONC_{it}$	Assets of the five largest banks as a share of total commercial banking assets (%)	440	89.9	13.7	33.4	100.0
ROE_{it}	Commercial banks' pre-tax income to total equity (%)	440	29.2	20.6	−2.2	168.9
MOB_{it}	Log of mobile phone subscriptions per 100 in habitants	440	3.2	1.7	−3.7	5.1
$INST_{it}$	An index of all six WGI indicators using PCA	440	0	2.2	−4.9	5.3
$POPD_{it}$	Log of population density (people per sq. km of land area)	440	4.0	1.5	0.8	6.4

Source: Table by authors

Table 1. Key descriptive statistics of all variables

Country	Bank deposits (% of GDP)		Bank credit to private Sector (% of GDP)		Bank credit to deposit ratio		Bank lending rate spread	
	2000–2009	2010–2019	2000–2009	2010–2019	2000–2009	2010–2019	2000–2009	2010–2019
Algeria	41.81	46.50	11.42	19.73	24.37	40.03	4.73	6.25
Angola	15.47	31.88	7.28	18.66	31.28	56.09	39.15	12.08
Botswana	35.34	41.44	20.94	30.99	56.73	71.58	6.57	5.85
Burundi	17.10	21.47	16.28	18.34	92.82	80.64	8.55	8.00
Egypt	73.67	68	49.43	28	62.05	40	5.31	5
Eswatini	17.96	25.18	15.57	20.64	80.06	80.12	6.71	6.59
Gambia	16.86	30.39	7.95	8.14	38.13	26.92	13.70	14.94
Kenya	30	38.60	25	33.02	75	81.33	10	7.47
Lesotho	26.21	31.24	9.44	17.81	36.66	53.00	9.43	8.59
Madagascar	13.57	15.83	8.27	11.72	56.70	66.37	16.73	43.19
Malawi	11.63	20.66	5.50	12.20	39.04	54.14	19.61	28.23
Mauritania	13.02	18.54	17.63	19.58	149.27	147.34	14.01	11.48
Mauritius	84.29	97.59	68.74	93.80	76.62	94.88	9.56	2.92
Mozambique	19.56	39.56	11.10	25.36	50.47	61.02	9.15	7.77
Namibia	39.47	57.08	46.06	52.31	112.31	87.71	5.75	4.38
Nigeria	12.87	17.68	11.16	12.09	79.81	67.32	6.84	8.45
Rwanda	12.33	17.04	10.25	18.61	75.92	100.98	7.55	8.97
Sierra Leone	9.74	16.85	3.62	5.87	28.83	32.85	13.37	14.07
South Africa	55.36	60.07	69.02	67.38	118.56	109.74	3.26	3.26
Tanzania	15.14	18.04	7.43	12.76	41.73	67.80	10.46	7.18
Uganda	10.59	14.38	8.64	12.06	53.72	74.16	11.40	10.49
Zambia	16.28	18.84	7.82	11.91	48.35	58.26	16.81	5.47

Source: Table by authors

Table 2.
The trend of financial intermediation for countries under this study

Diagnostic test	Results	*p*-value	Results
Hausman test	$chi^2(12) = 28.89$	0.0041	Fixed effect
Variance inflation factor (VIF)	Mean VIF = 3.14		There is no multicollinearity
VIF > 10 or 1/VIF < 0.1	1/VIF ranges between 0.1 and 0.8		
Durbin and Wu–Hausman tests	Durbin (score) $chi^2(1) = 75.839$	0.0000	There is endogeneity
	Wu–Hausman F(1, 425) = 88.509	0.0000	
Breusch–Pagan/Cook–Weisberg test	$chi^2(1) = 33.18$	0.0000	Presence of heteroscedasticity
Wooldridge test for autocorrelation in panel data	F (1, 21) = 28.159	0.0000	There is first-order autocorrelation (serial correlation)
Skewness/kurtosis tests for normality	Chi^2 (2) = 24.54	0.0000	The data is not normally distributed

Source: Table by authors

Table 3.
Diagnostic results

deepening without and with control variables, respectively. When regressed without control variables (Table 4), the macroeconomic factors significantly influence financial deepening at a 1% significance level across different distributions (0.25, 0.50 and 0.75 quantiles). The location function and scale parameters (columns 1 and 2 of Table 4) show the linearity of the MMQR results and allow us to compare them with conventional linear regression results (2SLS for this paper). The MMQR results for location functions are statistically significant for all macroeconomic factors and consistent with 2SLS findings. Furthermore, the scale parameters are also substantial for all macroeconomic factors except for inflation, which confirms the differences between quantiles (0.25, 0.50 and 0.75) are significant. Thus, MMQR results are robust.

Table 4.
The macroeconomic factors on financial deepening using MMQR and 2SLS without control variables

			MMQR			2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
FD_{it}	Location	Scale	Q(0.25)	Q(0.50)	Q(0.75)	
$GDPPC_{it}$	12.54*** (2.148)	5.743** (2.327)	7.681*** (0.575)	10.61*** (1.250)	16.92*** (3.049)	12.54*** (0.704)
Constant	−68.67*** (14.19)	−29.79* (15.38)	−43.45*** (3.730)	−58.66*** (8.484)	−91.36*** (21.67)	−68.67*** (5.171)
$TRADE_{it}$	0.0700* (0.0364)	0.0826** (0.0378)	−0.00151 (0.0154)	0.0273 (0.0207)	0.0918* (0.0478)	0.0700** (0.0282)
Constant	17.32*** (2.545)	8.497*** (2.640)	9.964*** (1.091)	12.92*** (1.449)	19.56*** (3.320)	17.32*** (2.295)
RIR_{it}	−0.249** (0.103)	−0.279*** (0.106)	−0.00309 (0.0460)	−0.101* (0.0596)	−0.300** (0.126)	−0.249*** (0.0867)
Constant	24.75*** (1.554)	16.83*** (1.598)	9.902*** (0.680)	15.84*** (1.064)	27.80*** (2.735)	24.75*** (1.245)
RER_{it}	−0.0053*** (0.000506)	−0.0027*** (0.000470)	−0.00286*** (0.000337)	−0.0042*** (0.000384)	−0.0058*** (0.000655)	−0.0053*** (0.000795)
Constant	25.64*** (1.115)	15.38*** (1.036)	11.71*** (0.554)	19.21*** (0.839)	28.67*** (2.142)	25.64*** (1.043)
INF_{it}	−0.217*** (0.0358)	−0.0485 (0.0414)	−0.175*** (0.0129)	−0.194*** (0.0189)	−0.227*** (0.0446)	−0.217*** (0.0599)
Constant	24.56*** (1.218)	14.95*** (1.410)	11.70*** (0.402)	17.50*** (0.758)	27.79*** (2.151)	24.56*** (1.118)
Observations	440	440	440	440	440	440

Notes: Significance levels $*p < 0.1$, $**p < 0.05$; $***p < 0.01$; Standard errors in brackets
Source: Table by authors

Table 5.
The macroeconomic factors on financial deepening using MMQR and 2SLS with control variables

FD_{it}	(1) Location	(2) Scale	MMQR (3) Q(0.25)	(4) Q(0.50)	(5) Q(0.75)	2SLS (6)
Panel A						
$GDPPC_{it}$	9.978*** (0.783)	0.811* (0.491)	9.222*** (0.585)	9.650*** (0.672)	10.75*** (1.152)	9.978*** (0.765)
MOB_{it}	0.522 (0.367)	0.197 (0.230)	0.339 (0.275)	0.443 (0.313)	0.711 (0.540)	0.522 (0.408)
$INST_{it}$	3.951*** (0.363)	0.896*** (0.228)	3.116*** (0.269)	3.589*** (0.322)	4.808*** (0.536)	3.951*** (0.323)
$POPD_{it}$	4.060*** (0.555)	0.407 (0.348)	3.680*** (0.415)	3.895*** (0.475)	4.449*** (0.816)	4.060*** (0.435)
Constant	−67.74*** (6.650)	2.368 (4.169)	−69.94*** (4.981)	−68.69*** (5.659)	−65.47*** (9.776)	−67.74*** (6.057)
Panel B						
$TRADE_{it}$	−0.0175 (0.555)	−0.0168 (0.514)	−0.00152 (1.044)	−0.0141 (0.661)	−0.0347 (0.0662)	−0.0175 (0.0218)
MOB_{it}	2.545 (10.33)	−0.164 (9.559)	2.702 (19.42)	2.579 (12.30)	2.378* (1.231)	2.545*** (0.445)
$INST_{it}$	5.889 (11.52)	2.178 (10.66)	3.809 (18.95)	5.436 (12.01)	8.113*** (1.240)	5.889*** (0.351)
$POPD_{it}$	1.904 (16.55)	0.993 (15.31)	0.957 (30.69)	1.698 (19.44)	2.918 (1.951)	1.904*** (0.493)
Constant	8.153 (99.54)	10.08 (92.11)	−1.468 (187.2)	6.059 (118.6)	18.44 (11.86)	8.153** (3.255)
Panel C						
RIR_{it}	−0.277*** (0.0553)	−0.0520 (0.0367)	−0.228*** (0.0401)	−0.268*** (0.0515)	−0.328*** (0.0843)	−0.277*** (0.0617)
MOB_{it}	2.597*** (0.439)	0.0350 (0.291)	2.565*** (0.319)	2.591*** (0.405)	2.632*** (0.670)	2.544*** (0.423)
$INST_{it}$	5.826*** (0.525)	2.072*** (0.349)	3.896*** (0.363)	5.464*** (0.556)	7.873*** (0.760)	5.201*** (0.324)
$POPD_{it}$	2.239*** (0.688)	0.936** (0.457)	1.367*** (0.497)	2.075*** (0.648)	3.163*** (1.045)	0.0310*** (0.0044)
Constant	7.877** (3.077)	8.556*** (2.044)	−0.0917 (2.234)	6.382** (2.963)	16.33*** (4.702)	13.10*** (1.657)
Panel D						
RER_{it}	−0.0035*** (0.000484)	−0.0016*** (0.000368)	−0.0021*** (0.000491)	−0.0033*** (0.000488)	−0.0050*** (0.000646)	−0.0035*** (0.0006)
MOB_{it}	2.673*** (0.552)	−0.179 (0.420)	2.835*** (0.582)	2.693*** (0.541)	2.503*** (0.760)	2.597*** (0.435)
$INST_{it}$	5.410*** (0.651)	2.054*** (0.496)	3.557*** (0.634)	5.177*** (0.653)	7.360*** (0.842)	5.826*** (0.334)
$POPD_{it}$	2.535*** (0.879)	1.308* (0.670)	1.354 (0.912)	2.386*** (0.867)	3.777*** (1.194)	2.239*** (0.470)
Constant	6.048 (3.799)	7.745*** (2.893)	−0.940 (4.030)	5.168 (3.783)	13.40** (5.256)	7.877*** (2.431)
Panel E						
INF_{it}	0.0694** (0.0317)	0.0304* (0.0180)	0.0405 (0.0251)	0.0639** (0.0302)	0.101** (0.0458)	0.0694 (0.0462)
MOB_{it}	2.700*** (0.420)	−0.0138 (0.239)	2.713*** (0.333)	2.702*** (0.395)	2.685*** (0.607)	2.700*** (0.454)
$INST_{it}$	5.926*** (0.500)	2.185*** (0.284)	3.855*** (0.378)	5.532*** (0.560)	8.220*** (0.704)	5.926*** (0.348)
$POPD_{it}$	2.087*** (0.641)	1.139*** (0.365)	1.007** (0.504)	1.882*** (0.625)	3.284*** (0.922)	2.087*** (0.480)
Constant	4.980 (3.037)	7.440*** (1.727)	−2.073 (2.416)	3.641 (2.931)	12.79*** (4.401)	4.980* (2.644)
Observations	440	440	440	440	440	440

Notes: Significance levels *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$; Standard errors in brackets
Source: Table by authors

Tables 4 and 5 show that GDP per capita ($GDPPC_{it}$) strongly and positively influences the bank credit at a 1% significance level on all percentiles. However, the MMQR results shed more light on the heterogeneous impact of GDP per capita on financial deepening, whereby the coefficient of GDP per capita doubles at the 75th percentile compared to the 25th percentile. The results imply that the impact of economic development is more profound on a high level of financial deepening than on a low level. GDP per capita increases earnings for the population, which may lead to a rise in bank deposits and, consequently, bank credit (financial depth). The practical implication is that economic development has an increasing marginal benefit as financial depth increases. The 2SLS findings are similar to those of MMQR's location function and 50th percentile, consistent with previous studies in developing countries using linear regressions (Allen *et al.*, 2014; Aluko and Ibrahim, 2020; Boyd *et al.*, 2001; Djankov *et al.*, 2007).

Table 4 shows that trade openness ($TRADE_{it}$) positively and significantly impacts financial deepening at a 10% significance level at the 75th percentile but is insignificant at the 25th and 50th percentiles. These heterogeneous results imply that trade openness positively impacts the high level of financial deepening. The 2SLS and MMQR results for location function are the same and conform with previous studies in SSA countries using conventional regression methods (Aluko and Ibrahim, 2020). However, when regressed with control variables (Table 5), trade openness shows a negative but insignificant impact across all levels of financial deepening. The negative effect of trade openness on financial deepening is consistent with the findings of Ahmed (2013) in SSA countries and Nguyen *et al.* (2018) in emerging countries. This may be possible because of non-export-led trade.

Table 4 shows inflation (INF_{it}) has a negative and significant impact on financial deepening across all distributions in conformity with the inflation-finance theory (Huybens and Smith, 1999). However, the inflation coefficients are −0.18 at the 25th percentile, −0.19 at the 50th percentile and −0.23 at the 75th percentile, suggesting the adverse impact of inflation increases as the financial depth increases. Thus, countries with high financial depth must control the rise of inflation to minimise its effect on credit supply. However, the results are different in Table 5; when regressed with control variables, inflation positively and significantly impacts moderate and high financial deepening. The MMQR's location function results are similar to 2SLS.

Tables 4 and 5 reveal that real interest rates (RIR_{it}) negatively and significantly impact financial deepening at the 50th and 75th percentiles (when regressed without control variables) and across all the distributions of financial deepening (when regressed with control variables). MMQR results show that the coefficients of real interest rate increase as financial depth increases, confirming a substantial adverse on increasing financial deepening. These results suggest that rising real interest rates reduce financial deepening, especially at high levels, consequently minimising credit to the private sector. Thus, policymakers should carefully consider increasing real interest rates to control inflation, as it adversely affects the credit supply for investments. The MMQR's location function and 2SLS results are similar and align with the findings of Modugu and Dempere (2022). The real exchange rate (RER_{it}) negatively and substantially impacts financial deepening at a 1% significance level across all distributions, with the coefficients increasing as financial depth increases. This suggests that the real exchange rates adversely impact higher levels of financing deepening than the low levels. The results for 2SLS are the same as those for MMQR's location function and 50% percentile.

5.2.2 The effect of financial factors on financial deepening. Tables 6 and 7 present the MMQR and 2SLS results without and with control variables for the impact of financial factors on financial deepening. The MMQR results for location functions are similar to the 2SLS results. They both show a significant impact on financial deepening for all financial factors at a 1% significance level, confirming the robustness of results in Tables 6 and 7. Furthermore, the scale parameters in Table 6 are also significant for all the financial factors

			MMQR			2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
FD_{it}	Location	Scale	Q(0.25)	Q(0.50)	Q(0.75)	
$ZSCORE_{it}$	0.926*** (0.162)	0.320* (0.169)	0.669*** (0.0621)	0.752*** (0.0835)	0.999*** (0.205)	0.926*** (0.134)
Constant	8.746*** (2.319)	9.138*** (2.430)	1.389 (0.903)	3.775*** (1.211)	10.83*** (3.027)	8.746*** (2.189)
LIR_{it}	−0.588*** (0.0584)	−0.144** (0.0673)	−0.460*** (0.0204)	−0.521*** (0.0307)	−0.623*** (0.0769)	−0.588*** (0.0702)
Constant	33.98*** (1.851)	16.61*** (2.134)	19.28*** (0.612)	26.21*** (1.008)	38.03*** (3.297)	33.98*** (1.644)
$SPREAD_{it}$	−0.836*** (0.0701)	−0.182** (0.0712)	−0.669*** (0.0292)	−0.751*** (0.0431)	−0.898*** (0.0974)	−0.836*** (0.0971)
Constant	31.61*** (1.401)	15.97*** (1.423)	16.96*** (0.508)	24.20*** (1.027)	37.01*** (3.044)	31.61*** (1.391)
$CONC_{it}$	−0.173** (0.0826)	−0.119 (0.0877)	−0.0671* (0.0352)	−0.114** (0.0476)	−0.179** (0.0884)	−0.173** (0.0706)
Constant	38.04*** (7.685)	25.02*** (8.161)	15.80*** (3.250)	25.70*** (4.553)	39.43*** (8.585)	38.04*** (6.425)
ROE_{it}	−0.308*** (0.0464)	−0.171*** (0.0469)	−0.162*** (0.0316)	−0.221*** (0.0327)	−0.350*** (0.0598)	−0.308*** (0.0451)
Constant	31.46*** (2.180)	19.17*** (2.202)	15.21*** (1.118)	21.73*** (1.321)	36.21*** (3.600)	31.46*** (1.609)
Observations	440	440	440	440	440	440

Notes: Significance levels $*p < 0.1$; $**p < 0.05$; $***p < 0.01$; Standard errors in brackets
Source: Table by authors

Table 6.
The effect of financial factors on financial deepening using MMQR and 2SLS without control variable

Table 7.
The financial factors on financial deepening using MMQR and 2SLS with control variables

			MMQR			2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
FD_{it}	Location	Scale	Q(0.25)	Q(0.50)	Q(0.75)	
Panel A						
$ZSCORE_{it}$	0.639*** (0.155)	0.0165 (0.142)	0.624*** (0.0762)	0.636*** (0.133)	0.654** (0.275)	0.639*** (0.0990)
MOB_{it}	2.139*** (0.625)	−0.305 (0.574)	2.422*** (0.308)	2.194*** (0.538)	1.861* (1.110)	2.139*** (0.430)
$INST_{it}$	5.661*** (0.694)	1.943*** (0.636)	3.864*** (0.341)	5.311*** (0.593)	7.435*** (1.143)	5.661*** (0.327)
$POPD_{it}$	2.309** (0.917)	1.608* (0.841)	0.821* (0.451)	2.019** (0.786)	3.776** (1.581)	2.309*** (0.459)
Constant	−2.931 (4.828)	5.541 (4.429)	−8.059*** (2.384)	−3.930 (4.177)	2.127 (8.636)	−2.931 (2.766)
Panel B						
LIR_{it}	−0.224*** (0.0545)	0.0875*** (0.0328)	−0.306*** (0.0414)	−0.240*** (0.0519)	−0.139* (0.0787)	−0.224*** (0.0587)
MOB_{it}	2.013*** (0.427)	0.0441 (0.257)	1.972*** (0.326)	2.005*** (0.398)	2.056*** (0.619)	2.013*** (0.460)
$INST_{it}$	5.548*** (0.490)	2.215*** (0.295)	3.462*** (0.353)	5.140*** (0.544)	7.698*** (0.687)	5.548*** (0.344)
$POPD_{it}$	1.974*** (0.632)	0.898** (0.380)	1.128** (0.480)	1.808*** (0.602)	2.846*** (0.913)	1.974*** (0.470)
Constant	12.65*** (3.321)	6.506*** (1.999)	6.524** (2.543)	11.46*** (3.142)	18.97*** (4.825)	12.65*** (2.921)
Panel C						
$SPREAD_{it}$	−0.341*** (0.0768)	0.108** (0.0471)	−0.442*** (0.0582)	−0.365*** (0.0717)	−0.237** (0.111)	−0.341*** (0.0789)
MOB_{it}	2.226*** (0.421)	−0.107 (0.259)	2.326*** (0.321)	2.249*** (0.387)	2.123*** (0.613)	2.226*** (0.442)
$INST_{it}$	5.427*** (0.492)	2.209*** (0.302)	3.354*** (0.357)	4.939*** (0.534)	7.543*** (0.684)	5.427*** (0.347)
$POPD_{it}$	1.872*** (0.636)	0.903** (0.390)	1.025** (0.481)	1.673*** (0.596)	2.736*** (0.919)	1.872*** (0.469)
Constant	11.72*** (3.225)	7.484*** (1.978)	4.695* (2.456)	10.06*** (3.028)	18.88*** (4.695)	11.72*** (2.705)
Panel D						
$CONC_{it}$	−0.198** (0.0910)	−0.0342 (0.0819)	−0.165*** (0.0430)	−0.195** (0.0860)	−0.232 (0.167)	−0.198*** (0.0514)
MOB_{it}	2.354*** (0.706)	−0.0942 (0.636)	2.443*** (0.334)	2.361*** (0.668)	2.261* (1.295)	2.354*** (0.441)
$INST_{it}$	5.937*** (0.832)	2.072*** (0.749)	3.982*** (0.381)	5.796*** (0.771)	7.988*** (1.389)	5.937*** (0.337)
$POPD_{it}$	1.684 (1.062)	0.852 (0.956)	0.881* (0.500)	1.626 (1.002)	2.528 (1.928)	1.684*** (0.477)
Constant	26.11*** (9.533)	11.88 (8.583)	14.90*** (4.497)	25.30*** (9.046)	37.87** (17.38)	26.11*** (5.663)
Panel E						
ROE_{it}	−0.293*** (0.0372)	−0.0213 (0.0231)	−0.273*** (0.0306)	−0.290*** (0.0359)	−0.313*** (0.0526)	−0.293*** (0.0342)
MOB_{it}	1.057** (0.440)	−0.113 (0.273)	1.163*** (0.362)	1.069** (0.424)	0.951 (0.621)	1.057** (0.447)
$INST_{it}$	6.223*** (0.456)	1.574*** (0.283)	4.741*** (0.370)	6.050*** (0.467)	7.693*** (0.646)	6.223*** (0.320)
$POPD_{it}$	2.246*** (0.588)	1.192*** (0.365)	1.124** (0.481)	2.115*** (0.579)	3.360*** (0.831)	2.246*** (0.443)
Constant	18.79*** (2.684)	7.444*** (1.666)	11.78*** (2.213)	17.97*** (2.644)	25.74*** (3.813)	18.79*** (2.699)
Observations	440	440	440	440	440	440

Notes: Significance levels *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$; Standard errors in brackets
Source: Table by authors

except for bank concentration. This confirms the substantial differences between the different levels of financial deepening (the 25th, 50th and 75th percentiles).

MMQR results in Tables 6 and 7 show that financial stability ($ZSCORE_{it}$) positively and significantly influences financial deepening with a 1% significance level across all levels of distributions. A unit increase in financial stability increases financial deepening by 0.67% at the 25th percentile, 0.75% at the 50th percentile and 1.0% at the 75th percentile, respectively. These results suggest that financial stability has an increasing marginal benefit on financial deepening as the depth level increases. The location function and 50th percentile results are consistent with the 2SLS results.

Table 6 shows that bank lending interest rate (LIR_{it}) and bank lending–deposit rate spread ($SPREAD_{it}$) negatively impact financial deepening, with a 1% significance level across all distributions. A 1% increase in bank lending interest rate reduces bank credit by 0.46% at the 25th percentile, 0.52% at the 50th percentile and 0.62% at the 75th percentile. Increasing the bank lending–deposit rate spread by 1% diminishes bank credit at 0.67% at the 25th percentile, 0.75% at the 50th percentile and 0.90% at the 75% percentile. The coefficients of both indicators increase as the financial depth increases. These results imply that the high bank lending interest rate and bank lending–deposit rate spread have substantial adverse effects on higher than lower levels of financial deepening. When bank lending interest rates and bank lending–deposit rates spread are regressed with control variables, they show diminishing marginal effects (Table 7). This suggests that when there are strong institutional factors, high population density and easy finance access, the negative impact of these indicators on financial deepening diminishes. The MMQR results for location functions and 2SLS are similar, consistent with previous findings using conventional regression methods (Assefa, 2014; Baoko *et al.*, 2017; Enisan and Oluwafemi, 2015; Schelling and Towbin, 2022; Sharma and Gounder, 2012; Shijaku and Kalluci, 2013).

The MMQR results in Tables 6 and 7 reveal that bank concentration ($CONC_{it}$) has an increasing marginal adverse on financial deepening as the depth increases. This means that higher bank concentration reduces competition and, consequently, lowers bank lending, especially at higher levels of financial deepening than lower. The MMQR results for location functions and 2SLS are similar and are in line with market power theory and previous empirical studies using mean regressions (Beck and Demirgüç-Kunt, 2006; Le Roux *et al.*, 2017; Ryan *et al.*, 2014).

Return on equity (ROE_{it}), as an indicator of financial efficiency (in terms of profitability), negatively and significantly impacts financial deepening with a 1% significance level. The MMQR results show that a 1% increase in return on equity reduces bank lending by 0.16% at the 25th percentile, 0.22% at the 50th percentile and 0.35% at the 75th percentile. The increase in coefficients suggests higher returns on equity significantly reduce bank lending as financial depth increases. The location function and 2SLS results are consistent with the findings of Beck and Demirgüç-Kunt (2006).

The control variables (population density ($POPD_{it}$), mobile phone subscription (MOB_{it}) and institutional quality ($INST_{it}$)) positively and significantly influence financial deepening across all distribution levels, except when regressed with trade openness. The findings are consistent with previous studies (Allen *et al.*, 2014; Sanga and Aziakpono, 2022, 2023). Financial access (indicated by mobile phone subscriptions) positively and significantly influences financial deepening.

6. Policy implications and conclusion

This paper investigates the heterogeneous effects of macroeconomic and financial factors across various distributions of financial deepening in Africa using quantile regression in 22

African countries from 2000 to 2019, employing MMQR and 2SLS methods. The empirical analysis shows the following results: First, GDP per capita positively and significantly impacts financing deepening with an increasing marginal benefit as financial depth increases, implying the essence of economic development on financial deepening. Second, trade openness has a significant and positive influence on financial deepening only at the 75th percentile, suggesting that the impact of trade openness is only on high levels of financial depth. Third, real interest rate, real exchange rate and inflations negatively and significantly affect financial deepening, especially at the high levels of financing deepening than the low levels. Fourth, financial stability positively and substantially influences financial deepening with an increasing marginal benefit as the financial depth increases. Bank lending interest rate, bank lending–deposit rate spread, bank concentration and return on equity negatively and substantially impact financial deepening, especially at higher than lower levels. Finally, we demonstrated that the three dimensions of financial development: financial access (indicated by mobile phone subscription), financial stability (indicated by *Z*-score) and financial efficiency (indicated by return on equity) have a significant impact on the fourth dimension of financial development: financial deepening.

Overall, the findings suggest that development partners and policymakers can strive to enhance economic development, trade openness and financial stability, which will increase financial depth. At the same time, they should control and reduce the adverse effects of higher real interest rates, exchange rates, inflation, bank lending interest rates and spread, bank concentration and return on equity on financial deepening. However, the heterogeneity analysis based on MMQR suggests prioritising specific actions for different countries. For instance, our data set shows countries with high financial deepening are Mauritius, Namibia and South Africa (with over 50% of bank credit to the private sector). These countries can focus on enhancing economic development, trade openness and financial stability while reducing inflation, real interest rates, bank lending–deposit rate spread, exchange rate volatility, bank concentration and excessive return on equity. On the other hand, countries with shallow financing deepening, such as Gambia, Madagascar, Malawi, Tanzania, Sierra Leone, Uganda and Zambia (with less than 15% of bank credit to the private sector), can concentrate on minimising the bank lending interest rate and bank lending–deposit rate spread as they have an adverse effect on financial deepening. Furthermore, policymakers in countries with shallow financing deepening can endeavour to improve export-led trade by removing all trade barriers as envisaged by the 2063 African Union Agenda. These practical implications underscore the relevance of our research for policymakers.

Note

1. The location and scale functions maintain the linearity of the quantile and make it possible to contrast the MMQR results with other estimates obtained from standard mean estimation methods.

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Appendix

Table A1.
Correlation matrix for macroeconomic factors

	Variables	1	2	3	4	5	6	7	8	9
1	FD_{it}	1								
2	$GDPPC_{it}$	0.65***	1							
3	$TRADE_{it}$	0.12*	0.34***	1						
4	RIR_{it}	−0.14**	−0.30***	−0.09	1					
5	RER_{it}	−0.30***	−0.47***	−0.28***	0.24***	1				
6	INF_{it}	−0.17***	−0.03	0.14**	−0.33***	−0.02	1			
7	MOB_{it}	0.38***	0.45***	0.06	0.02	−0.03	−0.27***	1		
8	$INST_{it}$	0.66***	0.54***	0.28***	−0.01	−0.24***	−0.25***	0.30***	1	
9	$POPD_{it}$	0.02	−0.38***	−0.29***	0.11*	0.23***	−0.06	−0.06	−0.18***	1

Notes: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: Table by authors

Table A2.
Correlation matrix for financial factors

	Variables	1	2	3	4	5	6	7	8	9
1	FD_{it}	1								
2	$ZSCORE_{it}$	0.31***	1							
3	LIR_{it}	−0.37***	−0.17***	1						
4	$SPREAD_{it}$	−0.38***	−0.12*	0.93***	1					
5	$CONC_{it}$	−0.12*	−0.03	0.16***	0.20***	1				
6	ROE_{it}	−0.31***	−0.26***	0.16**	0.12*	0.24***	1			
7	MOB_{it}	0.38***	0.18***	−0.37***	−0.25***	−0.08	−0.37***	1		
8	$INST_{it}$	0.66***	0.14**	−0.30***	−0.31***	0.09	0.01	0.30***	1	
9	$POPD_{it}$	0.021	−0.13**	0.04	−0.003	−0.19***	0.06	−0.06	−0.18***	1

Notes: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: Table by authors

Corresponding author
Bahati Sanga can be contacted at: bahati@sun.ac.za