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Article

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Fintech, bank funding, and economic growth in Sub-Saharan Africa

Tafirei Mashamba^{1,2*} and Shenaaz Gani¹

Abstract: The emergence of financial technology (Fintech) has greatly impacted the financial landscape in Sub-Saharan Africa (SSA) in recent years. The impact on bank funding and economic growth in the region cannot be ignored. This paper examines the extent to which Fintech has affected bank funding and economic growth in the region by utilizing data from 56 banks across 19 SSA economies between 2010 and 2020. The analysis was conducted using a covariance-based structural equation modeling method. The results show that Fintech disruptions have triggered an increase in equity funding for banks, while having negligible effects on deposit and long-term debt financing. The study also outlines that Fintech's limited size within the financial system has ultimately restricted its effects on economic growth in SSA. Furthermore, the study did not find evidence of Fintech mediating the impact on economic growth via the bank funding channel, suggesting that SSA banking systems are capable of resisting Fintech disruptions for financial stability. Overall, these findings highlight the resilience of bank funding structures to Fintech disruptions, emphasizing the importance of prudent funding management and continued investment in Fintech for sustained economic growth in Sub-Saharan Africa. However, as Fintech continues to evolve and grow, policymakers should remain vigilant and monitor its impact on the financial system and economic growth in the region. By understanding the implications of Fintech on bank funding and economic growth in SSA, this paper contributes to the ongoing discussion on the potential benefits and challenges of technological innovations in the financial sector.

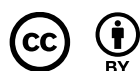
Subjects: Economics and Development; Banking; Economics

Keywords: Fintech; bank funding; economic growth; Sub-Saharan Africa; structural equation modeling

JEL classification: G1; O1; O4; C3

1. Introduction

The Fourth Industrial Revolution (4IR), characterized by advances in robotics, the Internet of Things (IoT), and artificial intelligence, is reshaping the way we live and work. In finance, the emergence of new financial technologies (Fintech), such as electronic money, mobile money, digital banking, crowdfunding platforms, and distributed ledger technology, is changing the financial landscape in unprecedented ways (Allen et al., 2021, Lagarde, 2018). The Financial Stability Board (2017: 7)



defines Fintech as “technology-enabled innovation in financial services that could result in new business models, applications, processes, or products with an associated material effect on the provision of financial services”.

In particular, mobile money has significantly transformed the financial landscape in Sub-Saharan Africa (SSA) region (Demirguc-Kunt et al., 2018; Sy et al., 2019). Mobile money refers to the financial services provided through mobile phones, allowing for the transfer, making, and receiving of payments, especially for the unbanked population (GSMA, 2021). The World Bank (2018) reports that, in many African countries, over 20% of the population has a mobile money account. Owing to its wide adoption and usage, the SSA region is a global leader in mobile financial services (Demirguc-Kunt et al., 2018; GSMA, 2021; Theobald, 2015). Fintech spurred by mobile money has significantly reduced financial exclusion in the region, which is characterized by weak financial infrastructure and limited financial service options (Aron, 2018).

One strength of mobile money is the provision of endless, instant, and frictionless money transfers among users. The growth of mobile money services has enabled users not only to transfer, make, and receive payments but also to make merchant payments, micro-savings, and microloans that were previously unavailable to the unbanked (Nan et al., 2021). Fintech, therefore, deepens the financial system by improving financial inclusion in SSA, while enhancing efficiency. The introduction of mobile money has not only transformed social life and business conduct but also disrupted traditional banking services (Nan et al., 2021). The disruption of traditional banking services has set the stage for financial liberalization and greater accessibility to financial services by SSA's growing population.

However, the current understanding of the impact of fintech on traditional banking and economic growth is limited. While several studies have examined the effects of Fintech on traditional banking performance, risk-taking behavior, stability, monetary policy, and financial inclusion (e.g., Dunne & Kasekende, 2018; Eilu & Auma, 2017; Ky et al., 2019; Liu et al., 2017; Lv et al., 2022; Mothobi & Grzybowski, 2017; Ndwiga, 2020; Nguena, 2020; Safiullah & Paramati, 2022), there is a lack of research that explores the impact of Fintech on economic growth through the bank funding channel. Specifically, the potential unintended and destabilizing effects of Fintech competition on bank funding, lending behavior, financial stability, and economic growth remain relatively unexplored. Therefore, a significant knowledge gap needs to be addressed in this area.

This study aims to fill this knowledge gap by examining how the growth of Fintech activities affects economic growth through the bank funding channel. Fintech's entry into funding markets can change banks' funding models, potentially leading to unintended consequences that affect lending behavior, financial stability, and economic growth. Previous research found that Fintech's entry into the traditional banking system increased banks' deposit costs and drove banks toward unstable wholesale funding (e.g., Farag et al., 2019). As a result, Fintech activities could have unintended and destabilizing effects on bank funding.

The present study argues that given the central role of banks in sub-Saharan African economies, the sensitivity of bank lending to funding conditions, and stability issues arising from heightened competition in funding markets between fintech and incumbent banks, Fintech developments could have unpremeditated effects on economic growth through shifts in banks' funding structures. Traditionally, banks source most of their funds from retail deposits, a segment that faces stiff competition from new fintech players. Studies from other emerging economies have revealed that Fintech erodes bank deposit funding, as seen in Buchak et al. (2021) and Zhu and Lu (2021). This highlights the potential for Fintech advancements to cause inadvertent impacts on banks' funding structures—a critical factor determining lending patterns and overall financial stability. Consequently, this could trigger a ripple effect on economic growth.

Our focus on the Sub-Saharan African region is motivated by several institutional, structural, political, and economic factors that distinguish African experiences from other emerging

economies. For instance, while banks and Fintech players in Asian economies work in harmony, the two players aggressively compete in SSA (Alexander et al., 2017), highlighting the importance of understanding how competition in funding markets affects bank funding and its potential impact on business and economic activity. Consequently, our findings have important policy implications for SSA.

Second, although the Sub-Saharan African region is recognized as a global leader in Fintech developments, especially in mobile money, the region still lags behind other developing regions such as East Asia, the Pacific, and South Asia in terms of economic growth (Ekanayake & Thaver, 2021). While finance has been known to promote economic growth by enhancing financial inclusion (Levine, 2005; Levine & Zervos, 1998), the contribution of Fintech to economic growth through improvements in financial inclusion in SSA is still uncertain. Therefore, there is a need to investigate how Fintech developments affect the conventional intermediary function of banks and economic growth in this region. Our research findings offer valuable insights for banks, central banks, and governments in SSA to implement or enhance existing policies that would fortify the effectiveness of Fintechs and financial markets.

Third, African banks rely on deposits for funding and have limited reliance on debt because of the limited development of other funding sources (Mecagni et al., 2015). Cross-border financing is also limited, but growing (Theobald, 2015). Given that bank credit supply is sensitive to funding conditions (Mecagni et al., 2015), funding dynamics may negatively affect bank lending, with dire consequences for economic activity in the SSA region. However, the overall Fintech sector in SSA is still small, but it is growing rapidly (Yermack, 2018). Consequently, the size of the Fintech sector in SSA may not have a significant impact on bank activities and economic growth, as noted by Frost (2020), who documents that Fintech activities are generally small relative to the overall financial system. As a result, the impact of Fintechs on banks' activities and economic growth in SSA remains ambiguous. This research aims to inform policymakers and regulators by addressing the knowledge gap on the relationship between Fintech, bank funding, and economic growth in SSA, emphasizing the mediating effect of bank funding on the Fintech-growth nexus.

The study found that Fintech funding disruptions do not significantly impact bank deposit funding or long-term funding structures in Sub-Saharan Africa. The study also found no evidence that bank funding acts as a mediator between Fintech and economic growth. In other words, bank funding does not play an important role in the mechanism through which Fintech affects regional growth. The study also found that Fintech had no significant indirect effect on economic growth in Sub-Saharan Africa. The findings suggest that increased Fintech competition in funding markets may not have significant implications for banks' funding structures or economic growth in the region. However, policymakers should remain vigilant and continue to monitor Fintech's impact on financial stability and economic growth.

The remainder of this paper is organized as follows. The next section reviews related studies and develops the research hypotheses. The next section discusses the research methodology employed to answer the research objectives, followed by a presentation and discussion of the research findings. Finally, section five concludes the paper by outlining the implications of the findings.

2. Literature review and hypotheses

Fintech has been a key driver of innovation in the global financial sector, and its impact on traditional banks has been a subject of scholarly research in recent years. A growing body of literature has demonstrated that banks exposed to Fintech developments in emerging economies experience significant deposit outflows (Buchak et al., 2021; Zhu & Lu, 2021). Prior studies have focused primarily on the impact of Fintech on deposit markets, with little attention paid to the impact on equity and debt funding. Given that banks adjust their funding mix in response to funding disruptions, it is important to examine their impact on all forms of funding. This study examines the impact of Fintech on banks'

funding structures in Sub-Saharan Africa, specifically looking at the implications for economic growth.

2.1. Fintech and bank funding

Banks play a critical role in financing economic activity worldwide, with retail deposits being their key source of funding (Gonzalez-Hermosillo et al., 2013). Owing to their stability, deposits provide a reliable source of funding for banks (Agnese & Vento, 2020; Bace, 2016; M. R. King, 2013). However, with the entry and growth of Fintech companies, significant competition is emerging for banks in funding markets (Teutio et al., 2021). Banks and Fintech companies compete for similar funding, including deposits and equity issuance (Shapiro et al., 2022), although Fintech obtains notable funding from venture capitalists. Despite the literature on the disruptive effects of Fintech companies on traditional banking growing, there is a dearth of empirical literature on the impact of Fintechs on banks' funding models, partly because Fintech is still nascent (Zalan & Toufaily, 2017). A few studies have attempted to explore how fintech affects bank deposit funding.

For example, Buchak et al. (2021) explore the equilibrium effect of Yu'eobao,¹ a money market fund with deposit-like features operated by Alipay,² on retail deposit funding for Chinese banks. They found that a 1% growth in Yu'eobao reduces household deposits by 7% to 9%, with cities and banks with high exposure to new Fintech suffering the largest deposit contraction. Similarly, Zhu and Lu (2021) examine the effect of Yu'eobao on commercial bank deposits using a 2SLS estimator. Their results were consistent with Buckak et al. in that banks whose deposit base was more exposed to Fintech in the short run experienced significant deposit contraction. However, the long-run findings showed that banks exposed to Fintech experienced higher loan and deposit growth. This was attributed to the strategies adopted by affected banks, which offered innovative deposit products, raised deposit interest rates, and increased wholesale funding. In general, Buchak et al. (2021) and Zhu and Lu (2021) emphasize the disruptive effects of Fintech on bank deposit funding.

Farag et al. (2019) show that the entry of Lending Club and Prosper, Fintech players, increased bank deposit costs by approximately 11% in the US. Banks responded to this funding competition by increasing wholesale funding and shifting their liabilities toward unstable non-deposit funding. However, these studies only focused on the effect of fintech on bank deposit funding. We argue that Fintech competition in funding markets affects deposit funding and other funding structures, such as equity and debt. Compared to bank deposits, Fintech companies offer a higher but riskier return to investors, attracting low-risk-averse investors to invest in Fintech products more than banks, resulting in a contraction in bank funding (Farag et al., 2019).

Allen et al. (2021) document that peer-to-peer lenders (Fintechs) directly connect investors (funding suppliers) and borrowers, presenting stiff competition to banks in both the funding and credit markets. Similarly, in Kenya, Ndung'u (2022) found that the introduction of M-Akiba encouraged micro-savings in government securities, but unfortunately at the expense of bank funding. However, Kubuga and Konjaang (2016) suggest that a lack of liquidity hampers individuals from depositing large sums of cash on mobile money agents, as most agents are micro and small enterprises that rely on self-financing. They argue that mobile money platforms in Sub-Saharan Africa offer convenience, whereas banks are liquid and therefore offer guaranteed access to cash. Hence, individuals would prefer to save small amounts for short periods in their mobile wallets but save large amounts for long periods at banks. This makes the impact of Fintech on bank funding ambiguous.

Nonetheless, Mansilla-Fernandez (2017) reports that Fintech companies have successfully grown in countries with high bank concentration and net interest margins, such as Sub-Saharan Africa, implying that incumbent banks are likely to face stiff competition. Hence, this study argues that Fintech developments provoke banks to shift to other funding sources, such as long-term debt and

equity financing, in response to Fintech competition. Therefore, we propose the following hypotheses:

H₁: *Fintech funding disruptions do not have a significant impact on banks' equity funding in SSA countries.*

H₂: *Fintech funding disruptions do not have a significant impact on bank deposit funding in SSA countries.*

H₃: *Fintech funding disruptions do not have a significant impact on banks' long-term funding in SSA countries.*

2.2. Fintech, bank funding, economic growth

Over the past few decades, the financial technology (Fintech) industry has grown rapidly, disrupting the traditional banking sector and changing the way financial services are accessed. Fintech companies leverage technology to provide consumers with more convenient and accessible financial services, often at a lower cost than traditional banks do (Agarwal & Zhang, 2020). This has led to increased competition in the financial services industry (Liem et al., 2022) and put pressure on banks to adapt and innovate to remain relevant. One of the key ways in which fintech impacts the banking sector is through its influence on bank funding (Carney, 2017). Traditionally, banks have relied on deposits from customers to fund their operations (Gonzalez-Hermosillo et al., 2013). Fintech companies have revolutionized financing by introducing novel ways of funding, such as peer-to-peer lending and crowdfunding. These alternatives have seen a rise in popularity among consumers and small businesses, potentially affecting traditional bank funding.

This shift in how banks are funded has both positive and negative implications for economic growth. On the one hand, fintech is increasing access to credit for individuals and businesses that may have been underserved by traditional banks (Dolson & Jagtiani, 2021; Jagtiani & Lemieux, 2019). This can help spur entrepreneurship and innovation, leading to job creation and economic growth (Hau et al., 2021). Additionally, Fintech can help to reduce the cost of borrowing, making it easier for businesses to invest in new projects and expand their operations. However, there are concerns that the rise of fintech could lead to a decrease in the availability of credit for certain types of borrowers (Eca et al., 2022). For example, fintech companies may be less willing to lend to businesses with lower credit scores or to those in industries that are perceived as risky. This could lead to a concentration of credit among a small number of large and established businesses, thereby hindering competition and innovation.

Another potential concern is that increased competition from fintech companies could lead to a decline in the profitability of traditional banks (Lv et al., 2022). This could, in turn, lead to a decrease in the amount of capital banks have available to lend, potentially slowing economic growth. Overall, the relationships between fintech, bank funding, and economic growth are complex and multifaceted. Although fintech has the potential to increase access to credit and reduce borrowing costs, there are also concerns about its impact on competition and the availability of credit for certain types of borrowers. As the fintech industry continues to evolve and disrupt the financial services sector, it is important for policymakers to monitor these developments and ensure that they support economic growth and financial stability. Thus, we propose the following hypotheses:

H₄: *Bank funding does not mediate the relationship between fintech and economic growth in SSA countries.*

3. Research methodology

3.1. Data and sample

This study utilizes bank-level data from S&P Capital IQ and country-level macroeconomic and financial market data from the World Bank Economic Indicators for each country. Fintech, specifically mobile money activities data, is retrieved from the International Monetary Fund's Financial Access Survey data (<https://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C>). This study covers the period from 2010 to 2020 to ensure data completeness and consistent representation across countries and over time. The population consists of banks in the Sub-Saharan Africa region; however, this study is limited by the availability of data. We were only able to obtain data for a small, but representative, sample of banks in Sub-Saharan Africa. This means that our findings may not be generalized to all Sub-Saharan African economies. Furthermore, we acknowledge that our sample is not perfect and that it is possible that survivorship bias may have affected our results since banks that were no longer in operation would not have been included in our sample. We attempted to mitigate survivorship bias by collecting data from multiple sources. However, we were ultimately limited by the availability of data. We encourage other researchers to use proprietary data to address survivorship bias in more detail in future studies.

The sample comprises 56 commercial banks from 19 economies, with Nigeria, Ghana, and Kenya having a larger representation than those of relatively underdeveloped states such as Uganda, Niger, and Eswatini. See Appendix 2 for the country breakdown and the number of banks included. The data were transformed using natural logarithms to mitigate extreme values and alleviate the influence of outliers (Wooldridge, 2015). Furthermore, point estimates on a natural logarithmic scale are easily interpretable as approximate proportional differences (Gelman & Hill, 2007). This study utilized an unbalanced panel dataset containing missing observations. We address the specific features of panel data, including the fixed effects for both individual entities and countries and endogeneity. To account for fixed effects, we apply a fixed-effect structural equation modeling (SEM) approach while incorporating country-specific dummies into our empirical model to adjust for country effects. To control autocorrelation and heteroscedasticity, we invoke the *vce robust* option in Stata.

It is important to note that the models presented in equations (1- 3) below may be vulnerable to endogeneity (simultaneity) issues. This means that there may be a risk of bias in the correlation between fintech adoption and bank funding, for instance, financially stable banks might be more likely to adopt fintech solutions. Additionally, bank funding and economic growth may cause each other, with an increase in funding potentially resulting in greater economic growth and vice versa. As such, the independent variables could be correlated with the error term, leading to potentially biased coefficient estimates. To mitigate endogeneity, the study utilized the two-stage least squares (2SLS) technique for robustness testing. This technique leverages instrumental variables to eliminate the correlation between the independent variables and the error term (Angrist, 1991), thereby resulting in more reliable and unbiased coefficients. In line with the literature (Stone & Jeon, 2000; Williams et al., 2018), the study used lagged variables as instrumental variables. This is because lagged variables are correlated with the endogenous variable, but they are unrelated to the error term. We believe that this approach provides more reliable estimates of the mediating effects of fintech on the interplay between funding and fintech on economic growth in SSA.

3.2. Empirical specification

The objectives of the study were achieved by developing and estimating the following structural equations:

$$Fintech_{ij,t} = \alpha Coredep_{ij,t} + \psi LTF_{ij,t} + \phi EqF_{ij,t} + \varepsilon_{it} \quad (1)$$

$$Ecogrowth_{ij,t} = \zeta Coredep_{ij,t} + \theta LTF_{ij,t} + \lambda EqF_{ij,t} + \varepsilon_{it} \quad (2)$$

$$Ecogrowth_{ij,t} = \beta Fintech_{ij,t} + \vartheta gvtdebt_{ij,t} + \phi invflows_{ij,t} + \omega domcred_{ij,t} + \varepsilon_{it} \quad (3)$$

Where:

$ij,t = i^{th}$ bank in country j at time t ; Fintech=mobile money indicators proxies for Fintech; Coredep=retail core deposits; ltd=long-term funding; eq=equity funding; ecogrowth=economic growth; ε =error term; $\alpha, \psi, \phi, \zeta, \theta, \lambda, \vartheta, \phi, \omega$ = regression coefficients. The coefficients are represented by $a_1, b_1, c_1, a_2, b_2, c_2, e, f, \text{ and } g$ on the SEM path diagram in that order. Fintech, financial technology; gvtdebt, government debt; invflows, investment flows; domcred, domestic credit provided by banks scaled by GDP.

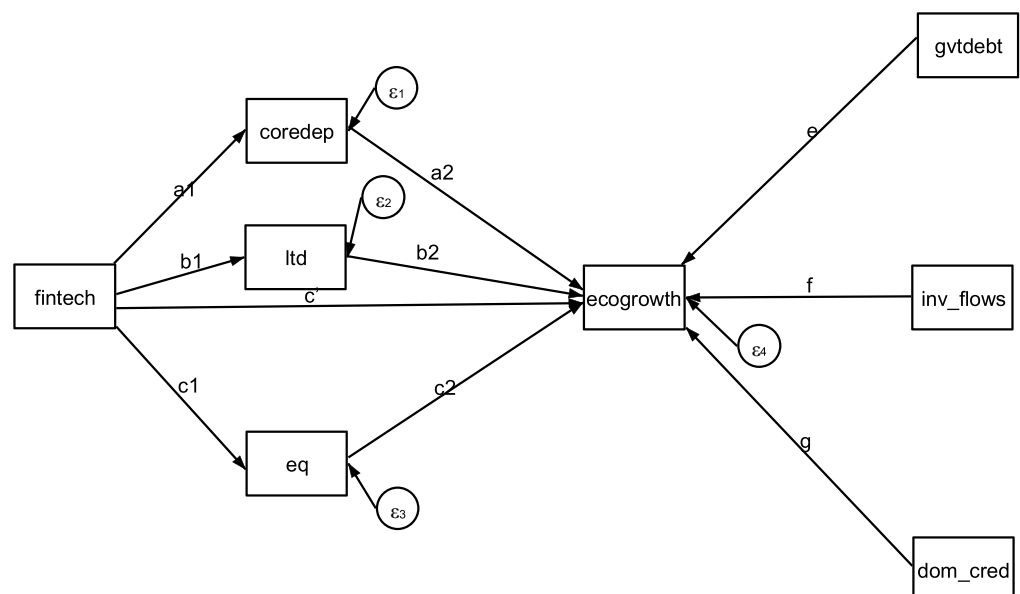
The coefficients $\alpha, \psi, \phi, \zeta, \nu, \theta$, and λ measure the direct effect of fintech on economic growth, whereas $\beta(c')$ estimates the indirect relationship between fintech and economic growth. ϑ, ϕ, ω estimate the effect of the control variables government debt, investment flows, and domestic credit respectively. Y is the bank funding instrument. Subject to data availability, this study analyzes three funding items: core deposits, long-term wholesale funding (bonds and other long-term instruments), and equity. Each funding instrument was scaled by total liabilities. *Fintech* is a Fintech index that will be created using PCA using the indicators described below. The path diagram for this analysis is as follows (See Figure 1).

The model was estimated using the covariance-based maximum likelihood approach and tested for goodness of fit using the Root Mean Square Error (RMSE), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI).

3.2.1. Variables

3.2.1.1. Fintech. In accordance with existing literature (Chinoda et al., 2021; Nguyen, 2020; Sarma, 2016), this study utilizes mobile phone indicators to develop a composite index for measuring Fintech activities in Sub-Saharan Africa. Mobile phone transactions are the primary and crucial alternative for conducting financial transactions in developing countries (Mehrotra & Nadhanael, 2016), thus making them an excellent proxy for Fintech activities in the SSA region (Nguyen, 2020). The Fintech index was developed using principal component analysis (PCA), which is a parametric

Figure 1. SEM path diagram.



approach (Camara & Tuesta, 2015) utilized to reduce the dimensionality of mobile money indicators and identify appropriate weights (Nguyen, 2020). The International Monetary Fund's Financial Access Survey is the source of the following mobile money indicators utilized to construct the Fintech index: mobile money accounts per 1,000 adults, mobile money outlets per 100,000 adults, number of mobile money transactions per 1,000 adults, number of mobile money transactions to GDP, number of registered mobile money per 1,000 adults, and number of registered mobile money agent outlets per 100,000 adults. These metrics signify the level of financial access, availability, and usage.

3.2.1.2. Dependent variable (economic growth). Economic growth is the outcome variable of interest in this study. Fintech has the potential to significantly impact economic growth by making it easier and cheaper to access financial services (Sahay et al., 2020). This can help to increase investment, boost productivity, and create jobs (Lukonga, 2021). Following the literature (Su et al., 2021, among others), we measure economic growth by the natural logarithm of the gross domestic product.

3.2.1.3. Mediating variables (bank funding). Banks, like any other business, must raise funds to finance their operations, manage liquidity, and meet regulatory requirements. To achieve these objectives, banks utilize a variety of funding instruments that can be distinguished based on various characteristics, such as investor type, instrument type, and priority (Gonzalez-Hermosillo et al., 2013). These instruments include deposits (both retail and wholesale), interbank borrowing, asset securitization, bonds, equity, and short-term funding instruments like Commercial Paper (CP), Treasury Bills (T-Bills), and Certificates of Deposit (CD). This study examines the impact of Fintech on three funding structures—retail core deposits, long-term debt, and equity funding—due to data availability.

Deposits are a source of funds that individuals or entities put into a bank account for safe-keeping with the potential to earn interest. Deposits can be classified into two types, namely, demand deposits and time deposits, and can be made by various investor types, such as individuals, businesses, or other entities. Furthermore, deposits can be divided into retail and wholesale deposits. Retail deposits tend to be more stable than wholesale deposits because they are generally considered to be “sticky” (Hartlage, 2012) due to a number of factors such as convenience, trust, customer loyalty, and deposit insurance. The ratio of retail deposits to total liabilities is utilized to determine the potential impacts of Fintech on bank deposits and economic growth. Fintech firms offer alternative digital banking services that provide higher interest rates than traditional banks (Navaretti et al., 2017). As a result, competition is increasing, and customers may prefer a Fintech option over a conventional bank. This shift in retail deposits from traditional banks to Fintech firms may lower banks' dependence on retail deposits as a source of funding.

Long-term debt funding is a financial tool that banks use to obtain funds for investments and loans with long-term returns. This funding is typically used for assets that are expected to generate returns over an extended period, such as commercial real estate loans and mortgages. Long-term debt funding can take the form of bonds, notes, or other debt instruments. The total value of long-term funding instruments is used in this study to measure long-term debt funding. The total value of long-term funding is scaled by total liabilities. Fintech companies have begun to issue bonds and other debt instruments to fund their operations, which offer investors attractive returns and are replacing traditional bank debt as a source of funding. As evidence, Giaretta and Chesini (2021) find that FinTech start-ups that are not regulated by financial authorities are more likely to be financed with long-term debt. This is because lenders perceive unregulated firms as being less risky, as they are not subject to the same regulatory requirements as regulated firms. The authors also discovered that FinTech start-ups with experienced and well-connected owners are more likely to be financed with long-term debt. This is because lenders view these owners as being more likely to be successful in managing the firm and repaying the debt.

3.2.1.4. Control variables. The study considers control variables that are commonly used in economic growth studies, including government debt, investment flows, and domestic credit to GDP. Existing literature generally supports the notion that high levels of government debt can impede economic growth by reducing private investment (Bahal et al., 2018). To mitigate the influence of government borrowing on the relationship between Fintech, bank funding, and economic growth, the study employs the ratio of total government debt to GDP as a control variable. Furthermore, investment flows, as measured by foreign investments to GDP, are typically viewed as a positive contributor to economic growth (Acquah & Ibrahim, 2020), as they can provide financing for new businesses and projects. Finally, the study employs the ratio of domestic credit provided by banks scaled to GDP to account for the potential impact of financial development on the relationship between Fintech, bank funding, and economic growth. Numerous studies, building on the seminal works of authors such as R. G. King and Levine (1993) and Levine (2005), have consistently found that growth in domestic credit provided by banks has a positive impact on economic growth (e.g., Paun et al., 2019; Yang, 2019).

4. Results and discussion

4.1. Descriptive statistics

Descriptive statistics describing the features of the data are presented in Table 1. Following Deng et al. (2021) the study reports both log-transformed and non-log-transformed descriptive statistics. Consistent with Wooldridge (2015), this study focuses on analyzing summary statistics for the

Table 1. Descriptive statistics

Variable	Mean	Std. Dev	Min	Max
Levels				
coredep_tl	0.66	0.22	0.22	0.98
ltd_tl	0.09	0.09	0.001	0.72
eq_tl	0.14	0.06	0.01	0.34
gvtdebt	30.99	21.21	4.66	129.31
inv_flows	1.2667	2.6279	-8.75	25.11
dom_cred	19.014	14.4075	2.26	106.04
gdp	2742.66	2269.78	315.7	11215.9
Fintech (in levels)				
mma1kreg	640.07	608.38	0.06	2007.44
mmareg	12 million	14.6 million	893 000	66 million
mmt	435 million	658 million	3 218 000	353 million
vmmt	11.62	2.31	5.64	15.54
Log transformation				
lncoredep_tl	-0.49	0.40	-1.55	-0.02
lnltd_tl	-2.83	0.89	-6.72	-0.33
lneq_tl	0.14	0.06	0.03	0.29
lngvtdebt	3.23	0.68	1.54	5.15
lninv_flows	-0.01	1.11	-3.00	3.22
lnindom_cred	2.71	0.70	0.82	4.66
lngdp	4.03	1.34	1.34	7.05

mma1kreg = mobile money accounts active per 1 000 registered adults; *mmareg* = mobile money accounts registered; *mmt* = mobile money transactions; *vmmt* = value of mobile money transactions; *coredep_tl*=coredeposits to total liabilities; *ltd_tl* = long-term debt to total liabilities; *eq_tl* = equity to total liabilities; *gvtdebt* = government debt; *invflows* = investment flows; *domcred* = domestic credit provided by banks scaled by gdp; *gdp* = gross domestic product; *ln* =natural logarithm.

variables in levels (non-log-transformed), that is, in ratio form, as this provides a clearer picture of the data characteristics.

The descriptive statistics in Table 1 show that deposits are the main source of funding for banks in the SSA used in the sample. This was confirmed by the low standard deviation of 0.22. This finding concurs with the literature that retail deposits are the main source of funding in emerging economies (Eyraud et al., 2021, Mashamba & Magweva, 2019; Gonzalez-Hermosillo et al., 2013). This practice is driven by the underdevelopment of capital markets in African economies. GDP per capita summary statistics show huge income disparities among the sampled countries. Countries such as Burkina Faso, Malawi, Mali, Niger, Rwanda, and Uganda fall within the low-income class category, whereas Botswana, South Africa, Mauritius, and Namibia are classified as upper-middle-income economies. These disparities reveal significant differences in the living standards across the Sub-Saharan African region. Nonetheless, most of the sampled countries fall within the lower-middle-income class, suggesting that African governments still need to address poverty in their economies.

Government debt to GDP averaged about 31% for the sampled economies, with a standard deviation of 21%. Although the average debt-to-GDP ratio for the sampled SSA economies seems appealing, the low statistics may be an indication of both low government debt and GDP, since most stagnant or developing countries have low debt-to-GDP ratios (World Population Review, 2022). Domestic credit to GDP, a proxy for financial development, averaged 19% during the sampling window, thereby confirming that Sub-Saharan economies still lag in terms of financial sector development. This calls for policies to bolster the financial sector's contribution to economic activities. As expected, the Fintech variable summary statistics are exciting. These statistics corroborate with literature that attributes higher financial inclusion in SSA to mobile money penetration (Demirguc-Kunt et al., 2018). Sy et al. (2019) allude that SSA leads the world in mobile money adoption. This development is commendable, because financial inclusion positively affects growth (Alhassan & Koaudio, 2019; Ifediora et al., 2022; Nan, 2019).

4.2. Correlation matrix

The correlation matrix presented in Appendix 1 indicates that there is no evidence of multicollinearity in the data as no variables exhibit a correlation higher than 0.70. However, the correlation matrix revealed interesting relationships between the variables. Specifically, there is a positive correlation (0.2177) between deposit and equity funding, implying that banks in SSA tend to simultaneously increase funding from both sources. This finding aligns with the notion that both core deposits and equity funding contribute to systemic stability (Iwanicz-Drozdzowska et al., 2021). Additionally, equity funding is positively associated with investment flows, suggesting that cross-border funding among banks in SSA is on the rise, a trend documented in previous research (Mathieu et al., 2019). Finally, our analysis reveals a positive correlation between Fintech and equity funding, indicating that banks in SSA respond to Fintech funding pressures by increasing their core equity funding levels.

4.3. Empirical findings

The SEM results are presented in Tables 2 and 3. Table 2 presents the direct and total effect findings, while Table 3 displays the indirect effect results. The model is a reasonably good fit, based on the SEM fit statistics and indices suggested by Schumacker and Lomax (2004).

$$\chi^2(df = 12) \rightarrow 321.2 \ (p = 0.000)$$

$$RMSEA \rightarrow 0.073$$

$$CFI \rightarrow 0.947$$

$$TLI \rightarrow 0.90$$

Table 2. Recursive model estimates

	Direct effects (1)	(2)	(3)	Total effects (4)	(5)	(6)
Variables	Coefficient	Standard error	Economic impact	Coefficient	Standard error	Economic impact
fintech <-						
coredep	-0.0049	0.0218	—	-0.0049	0.0218	—
ltd_tl	0.0305	0.0505	—	0.0305	0.0505	—
eq_tl	0.094***	0.0242	0.0056	0.094***	0.0242	0.0056
gdp <-						
coredep	0.1082	0.1349	—	0.1082	0.1349	—
ltd_tl	0.1315**	0.057	0.0873	0.1315**	0.057	0.0873
eq_tl	0.1745***	0.1225	0.0078	0.1745***	0.1225	0.0078
fintech	0.1727***	0.0509	0.1289	0.1926***	0.05	0.1437
gvtdebt	-1.3401***	0.081	-0.6801	-1.3401***	0.081	-0.6801
inv_flows	0.5263***	0.0449	0.4360	0.5263***	0.0449	0.4360
dom_cred	-0.6528***	0.0714	-0.3401	-0.6528***	0.0714	-0.3401

* $p < 0.01$ ** $p < 0.05$ *** $p < 0.1$.

coredep_tl = coredeposits to total liabilities; ltd_tl = long-term debt to total liabilities; eq_tl = equity to total liabilities; gvtdebt = government debt; invflows = investment flows; domcred = domestic credit provided by banks scaled by gdp; gdp = gross domestic product; fintech = fintech index.

Table 3. Indirect effect results

Variables	Coefficient	Std.err	Economic impact
Fintech			
coredep	0 (no path)	—	—
ltd_tl	0 (no path)	—	—
eq_tl	0 (no path)	—	—
Gdp			
Coredep	0 (no path)	—	—
ltd_tl	0 (no path)	—	—
eq_tl	0 (no path)	—	—
Fintech	0.0199	0.0142	—
Gvtdebt	0 (no path)	—	—
inv_flows	0 (no path)	—	—
dom_cred	0 (no path)	—	—

* $p < 0.01$ ** $p < 0.05$ *** $p < 0.1$.

coredep_tl=coredeposits to total liabilities; ltd_tl=long-term debt to total liabilities; eq_tl=equity to total liabilities; gvtdebt = government debt; invflows = investment flows; domcred = domestic credit provided by banks scaled by gdp; Fintech = Fintech index.

SRMR -> 0.059

GFI -> 0.868

Miller and Rodgers (2008) argue that statistical significance is not always a reliable indicator of economic importance or practical significance. They suggest that researchers should provide

context for their findings by presenting economic effect sizes. In line with this suggestion, the current study estimated and analyzed the economic impact of the findings. The economic effect is the regression coefficient, scaled by the standard deviation of the independent variable, and divided by the standard deviation of the dependent variable.³ This gives an estimate of the expected change in the dependent variable, based on a one-standard-deviation change in the independent variable. The formula calculates the economic effect of a change in an independent variable on a dependent variable. It considers the variability of the independent variable, as well as the strength of the relationship between the independent and dependent variables (represented by the regression coefficient). Columns 1 and 4 depict the regression coefficients and Columns 3 and 6 display the economic impact estimates.

The results, as shown in Table 2 and Columns 1 and 4, indicate a positive but statistically insignificant correlation between core retail deposits and fintech for both direct and total effects ($p > 0.05$). Surprisingly, despite expectations and extensive literature, this study finds no significant impact of fintech developments on bank deposit funding in Sub-Saharan Africa. Thus, the second hypothesis is supported. These results contradict the findings of Buchak et al. (2021) and Zhu and Lu (2021), who establish that bank deposits diminish in regions with high fintech adoption in China. Their research revealed that the launch of the mobile money fund product Yu'eobao by Alipay led to significant deposit contraction in areas where its usage was high. However, several factors in Sub-Saharan Africa may explain these results. First, banks' advantages over fintech companies are immensely robust in this region. Among these advantages, security, safety (attributed to stricter regulations), and strong branding and reputation play a vital role (Kubuga & Konjaang, 2016; Zalan & Toufaily, 2017). Hence, these strengths appear to offer banks a highly competitive edge over fintech companies.

Second, evidence suggests that banks in Sub-Saharan Africa have rapidly responded and adapted to fintech disruption via various strategies, such as partnerships and strategic alliances, as documented by Najaf et al. (2021). MShwari⁴ is an outstanding example. Banks' aggressive approach to fintech development appears to yield a stable flow of deposits.

Alternatively, the lack of threat to banks' deposit bases from the proliferation of mobile money services in the SSA region may be due to the unattractive interest rates offered on "cash-ins," or e-wallet deposits at mobile money agents, which are not comparable to bank deposits. In contrast to banks, most mobile money service providers treat these deposits as transitory with no interest paid. This may explain why the rapid growth of mobile money services has not posed a significant threat to banks' deposit bases. Furthermore, differences in the target market of Fintechs and banks may also play a role in explaining their effects on banks. Bejar et al. (2022) found that if new Fintech players focus on a market with limited banking presence, they are not perceived as a threat to traditional banks. In many SSA economies, mobile money operators reach out to individuals in remote areas with limited banking access, as well as underserved segments such as the poor, who were traditionally ignored by banks.

However, the empirical results from this study indicate that deposits did not have a significant effect on economic growth in Sub-Saharan Africa from 2010 to 2023. The coefficient for core deposits (ζ) was statistically insignificant ($p > 0.05$) despite having the expected positive sign. Therefore, this study found no evidence to support the view that bank deposits stimulated economic growth in Sub-Saharan Africa during the study period. This finding challenges the belief that retail deposits facilitate economic growth in emerging economies by providing banks with "cheap" funding to support their entrepreneurs. Ultimately, no evidence of mediation was found between Fintech and GDP through bank deposits.

Long-term debt funding and fintech have a positive and statistically insignificant point estimate ($\psi = 0.03$). Thus, the hypothesis that Fintech developments do not provoke banks in Sub-Saharan Africa to increase long-term debt funding is supported (H_3). Based on the empirical results, it can

be concluded that Fintech developments do not lead to an increase in long-term debt funding by banks in Sub-Saharan Africa ($\psi = 0.03$). This is likely due to the shallow and underdeveloped capital markets in the region, with bond markets being only a small fraction of the capital markets in most economies, and most bond issuances being made by governments and a few large firms (Soumaré et al., 2021). However, the study finds evidence for the mediating role of long-term debt funding in the relationship between Fintech and economic growth in the region, with a positive and statistically significant coefficient (0.1315) but negligible economic impact (0.09%). This suggests that Fintech stimulates economic growth in SSA by encouraging banks to use long-term debt funding instruments, which are associated with systemic stability (Gai et al., 2013).

On the other hand, the study finds that equity funding has a positive and statistically significant response to Fintech developments in the region ($\phi = 0.094$), with a one percent growth in Fintech activities resulting in a 9.4% increase in equity financing. Although the economic impact is small (0.06%), this response is commendable since a high dependence on equity funding by banks promotes financial stability (Lutfi et al., 2020; Norden & Stoian, 2014). The study also finds evidence of the mediation effect of equity funding on the relationship between fintech and economic growth in Sub-Saharan Africa, with a positive and significant coefficient ($\lambda = 0.1745$) and a small economic impact (0.008). Thus, Fintech developments influence economic growth in the region via changes in banks' equity funding, which is inconsistent with Hypothesis 4. This response could be a strategic move by banks to solidify their capital bases and compete with Fintech players.

The study demonstrates a significant positive relationship between Fintech and economic growth in Sub-Saharan Africa (SSA), which is consistent with previous research. The coefficient ($\beta = 0.1727$) indicates that a 1-unit growth in Fintech activities stimulates economic growth by about 17 units, *ceteris paribus*. Moreover, the total effect results reveal a positive and statistically significant impact of Fintech on economic growth (coefficient = 0.1926; $p < 0.05$). This finding indicates a positive relationship between Fintech and SSA growth during the study period. These results support previous research suggesting that Fintech promotes growth by reducing financial exclusion. Researchers such as Innes and Andrieu (2022), Alhassan and Koaudio (2019), Gosavi (2018), Eilu and Auma (2017), and Nan (2019) have established that Fintech serves as a catalyst for economic growth by facilitating improved household welfare and enabling small businesses to thrive. Using a difference-in-difference estimator, Nan (2019) demonstrated that mobile money plays a vital role in promoting economic growth in SSA. Similarly, Mothobi and Grzybowski (2017) found that mobile phones provide marginalized and unbanked population access to financial services, which helps to improve their living standards. Interestingly, mobile financial services benefit all income groups (Mothobi & Grzybowski, 2017), which further supports the positive effect of Fintech solutions on economic growth in SSA. In summary, the findings of this study indicate that Fintech contributes positively to economic growth in SSA. Previous research supports this conclusion, with Fintech seen as a tool for reducing financial exclusion and promoting economic growth in the region.

This study controls for macroeconomic factors, namely, government debt, investment flows, and domestic credit. The results show that government debt has a negative impact on economic growth ($\theta = 1.34$), with a one-unit increase in government debt decreasing economic growth by 1.34 units, all else being equal. A standard deviation increase in government debt decreases the economic output by 0.6801. These findings support the view that high government debt crowds out private investments and dampens economic growth (Checherita-Westphal & Rother, 2012; Heimberger, 2021). Net investment flows positively impact economic growth (Asamoah et al., 2019; Nyang'oro, 2017). A standard deviation increase in investment flows boosts economic growth by about 0.44 by providing much-needed capital for business establishment and growth (Calderon & Nguyen, 2015). However, the study finds a negative association between domestic credit, a proxy for financial sector development, and GDP ($\omega = -0.6528\%$). An increase in the standard deviation of domestic credit decreases economic growth by 0.34, consistent with

Ibrahim and Alagidede (2017) finding that rapid and uncontrolled credit growth dampens economic growth by promoting superfluous consumption and fueling inflation. The study also presents the indirect effect of Fintech on economic growth in SSA, which is outlined in Table 3.

The indirect effect of fintech on economic growth yields surprising results. While the Fintech variable is expected to have a positive impact on growth, the evidence suggests that this relationship is statistically insignificant ($p > 5\%$). Specifically, the study found that fintech developments in Sub-Saharan Africa (SSA) do not appear to influence economic growth through the bank funding channel. In other words, the study did not find any evidence to support the existence of a bank funding transmission mechanism through which fintech impacts economic growth in SSA. This finding has an important implication: The bank funding mechanism is not a relevant channel through which fintech affects economic growth in Sub-Saharan Africa (SSA). Therefore, it can be inferred that the funding structures of SSA banks are resilient to fintech developments. One possible explanation for this resilience is the underdevelopment of capital markets in SSA as well as the relatively small size of the fintech sector when compared to the overall financial system, which may limit its economic impact (Frost, 2020).

5. Robustness tests

Previous studies have revealed that the impact of Fintech on banks is heterogeneous, meaning that small and large banks are affected differently by Fintech developments (Liu et al., 2017; Sheng, 2021). Fintech tends to have a greater effect on large banks than on small banks because small banks are more proactive and agile owing to their size and low bureaucracy, enabling them to implement measures to counter increasing competition and changes in market conditions (Safiullah & Paramati, 2022). On the other hand, large banks have more significant capital bases for research and development, allowing them to respond to Fintechs by building their own internal competitive Fintech solutions. Given the contrasting perspectives on the size effect, this study controls for bank size in regressions.

Furthermore, the quality of bank assets may also influence the interplay between Fintech, funding structures, and economic growth, as high non-performing loans (NPLs) can impede bank lending activities and have destabilizing effects on the banking sector, which could then spill over into the real economy (Zhang et al., 2022). Eyraud et al. (2021) also observe that rising NPLs restrict banks' ability to provide new credit and support the economy. Their research, which uses bank-level and country data, provides new evidence that NPLs inhibit credit supply and economic growth in SSA. Therefore, to verify the reliability of the earlier findings, this study controls for banks' asset quality using the non-performing loans ratio. The findings of the robustness tests are presented in Table 4, where the results in Columns 1 to 3 relate to bank size, while Columns 4 to 6 present the results for NPLs. To conserve space, only the total effect findings were analyzed.

Table 4 presents the results that mirror the baseline findings in terms of coefficient signs and statistical and economic significance. Hence, it can be deduced that the empirical findings are robust to alternative estimations. Regarding the size variable, the estimates in Table 4, Column 1, indicate that the point estimate for this variable is 0.1971, which is statistically significant at the 0.05 level. Specifically, holding the other factors constant, a one-unit increase in banks' balance sheets results in an approximately 0.2 unit rise in economic growth. Moreover, a one standard deviation shift in bank size corresponds to a 0.34 rise in GDP, underscoring the association between banks' balance sheet growth and economic growth. These findings challenge Demirgüç-Kunt's et al. (2013) conclusion that the role of banks declines as economies progress. The study attributes this evidence to the critical role banks play in providing funding to businesses in emerging economies like sub-Saharan Africa. Indeed, banks appear to play a more significant role in economic growth than stock markets in developing countries such as Africa (Mecagni et al., 2015). Overall, the results suggest that large banks are pivotal for economic growth in sub-Saharan Africa by supplying corporate finance and fostering firm investment and growth.

Table 4. Robustness test results

Variables	Bank size			NPL		
	(1)	(2)	(3)	(4)	(5)	(6)
	Coefficient	Std.err	Economic impact	Coefficient	Std.err	Economic impact
fintech <-						
coredep	−0.0049	0.0218		0.0033	0.0221	—
ltd_tl	0.0305	0.0505		0.0448	0.0546	—
eq_tl	0.094***	0.0243	0.0056	0.1026***	0.026	0.0062
gdp <-						
coredep	0.1081	0.1214	—	0.0563	0.132	—
ltd_tl	0.1278**	0.0513	0.0849	0.1225**	0.0525	0.0814
eq_tl	0.2349**	0.1105	0.0105	0.2305*	0.1154	0.0103
fintech	0.1985***	0.0453	0.1481	0.2297***	0.0501	0.1714
gvtdebt	−0.9501***	0.0892	−0.4821	−0.9576***	0.0911	0.486
inv_flows	0.5861***	0.0412	0.4855	0.5484***	0.0436	0.4543
dom_cred	−0.3576***	0.0751	−0.1868	−0.3938***	0.0784	−0.1102
size	0.1971**	0.026	0.3412	0.211***	0.0274	0.3653
npl	—	—		−0.0144	0.0488	—

* $p < 0.01$ ** $p < 0.05$ *** $p < 0.1$.

coredep_tl = coredeposits to total liabilities; ltd_tl = long-term debt to total liabilities; eq_tl = equity to total liabilities; gvtdebt = government debt; invflows = investment flows; domcred = domestic credit provided by banks scaled by gdp; fintech = fintech index; size = bank size; npl = non-performing loans.

Furthermore, the NPL variable has a negative coefficient (−0.0144) that is statistically significant ($p > 0.05$). This finding indicates that despite the fact that an increase in non-performing loans slows economic growth, the effect is not statistically significant. Therefore, it can be inferred that non-performing loans do not adversely affect economic growth in Sub-Saharan Africa. These results contradict the commonly held belief that an increase in non-performing will reduce economic growth (Zhang et al., 2022). The findings suggest that the sampled banks in the sub-Saharan African region have implemented prudent credit risk-management practices.

As mentioned earlier, it is important to control endogeneity (simultaneity) in panel data studies. The study used two-stage least squares (2SLS), an instrumental variable technique, to control endogeneity. The results are presented in Table 5.

The 2SLS estimator was employed to re-estimate equations 1-3, and the results are presented in Table 5. The coefficients for each equation retain their statistical significance and signs, except for core deposits funding in equation 2. This provides evidence for the robustness of the empirical findings to endogeneity. The literature supports the positive impact of deposits on economic growth, as demonstrated by Ribaj and Mexhuani's (2021) study. Their research revealed that deposits can significantly influence economic growth by promoting investment, production, and employment. Therefore, this can contribute to an upswing in economic growth.

6. Conclusion

This study examines the effects of fintech on banks' funding models and the mediation effect of banks' funding structures on the relationship between fintech and economic growth in Sub-Saharan Africa from 2010 to 2020. Structural equation modeling was used for the analysis. The results can be summarized as follows: fintech → deposits → economic growth (no relationship identified); fintech → long-term debt funding → economic growth (strong positive path identified);

Table 5. 2SLS estimation results

Variables	Coefficient	Robust Standard Error	Economic impact
<i>fintech</i> <-			
<i>lncoredep_tl_lag</i>	−0.089	0.1495	−0.0421
<i>lnltd_tl_lag</i>	−0.0342	0.0835	−0.0361
<i>lneq_tl_lag</i>	0.5024	0.1237***	0.2713
<i>gdp</i> <-			
<i>lncoredep_tl_lag</i>	0.4501	0.1959**	0.1383
<i>lnltd_tl_lag</i>	0.3372	0.0762***	0.2312
<i>lneq_tl_lag</i>	0.3616	0.1537**	0.1268
<i>gdp</i> <-			
<i>fintech_lag</i>	0.1563	0.0402***	0.1047
<i>dom_cred_lag</i>	−0.3864	0.0765***	−0.3751
<i>gvtdebt_lag</i>	−1.2405	0.0764***	0.7215
<i>inv_flows_lag</i>	0.3643	0.0547***	0.3762

* $p < 0.01$ ** $p < 0.05$ *** $p < 0.1$.

fintech → equity funding → economic growth (strong positive path established); and fintech → bank funding → economic growth (no mediation). Based on these findings, the following conclusions were drawn.

Research shows that fintech development does not significantly affect bank deposits, indicating that banks remain resilient to new fintech players. While this suggests that banks are currently “safe” from fintech disruptions, they should consider changing their business models to become fintech enablers. The disruption caused by fintech in certain segments of bank offerings implies that banks need to remain agile and adaptive in withstanding pressure from fintech competitors. Fintech companies are encouraging banks to increase equity funding, which carries systemic stability connotations. Therefore, regulators and investors should be encouraged to support fintech solutions that positively affect financial stability. However, underdeveloped capital markets in Sub-Saharan African (SSA) economies pose challenges to banks’ long-term debt shifts in response to Fintech companies. SSA governments need to deepen and widen their debt markets by tapping into the resources held by institutional investors. Financial literacy campaigns can also aid locals’ participation in bond markets. In summary, banks should remain vigilant and resilient, whereas governments and stakeholders should continue to support fintech solutions and address market mechanisms to harness potential growth opportunities.

The study does not provide evidence to suggest any mechanism through which Fintech impacts economic growth via the bank funding channel. Therefore, it can be inferred that Fintech development does not have an indirect impact on economic growth through this channel. This leads to two potential conclusions. First, Fintech does not affect bank funding structures in SSA, possibly because of the competitive advantages that traditional banks possess, such as deposit protection and liquidity, as well as their strategic response to Fintech disruption. Second, the effect of Fintech on economic growth in SSA is potentially minimal, owing to the small size of the Fintech sector in relation to the overall financial system. As a result, bank funding in SSA appears to be resilient against Fintech disruptions, with no instability implications resulting from the emergence and growth of new Fintech players. However, it is important to implement measures that strengthen capital markets to widen the funding sources of banks’ and other financial institutions.

6.1. Limitations of the study

Although our study provides valuable insights, it is important to acknowledge its limitations. The study is limited by the availability of data. We were only able to obtain data for a small, but representative, sample of banks in Sub-Saharan Africa. Therefore, our findings may not be generalized to the entire population of banks in the region. This data limitation may also result in survivorship bias as we based our sample selection on data availability, potentially excluding failed or acquired banks. Hence our findings should be interpreted with caution, as they may be skewed towards successful banks and fintech companies, limiting the generalizability of our results to all of Sub-Saharan Africa. Despite this limitation, we believe that our findings are still valuable. Our study highlights important evidence, that is, the resilience of bank funding to Fintech disruptions in Sub-Saharan Africa which carry important implications for policy and practice. Nevertheless, future research should aim to collect more data from a wider range of banks in Sub-Saharan Africa, to provide a more comprehensive and generalizable understanding of the impact of fintech disruptions on bank funding and economic growth in the region.

6.2. Areas of further research

It is important to note that the impact of fintech on bank funding and economic growth is complex and multifaceted. There are many other areas that could be explored, such as:

- The role of regulatory frameworks: Fintech disruptions are often accompanied by changes in the regulatory environment. Future research could explore the extent to which regulatory frameworks in SSA countries facilitate or hinder the growth and adoption of fintech, and how this affects bank funding and economic growth.
- The impact on the credit market: Fintech disruptions are changing the way credit is offered and accessed in SSA. Future studies could investigate how fintech is impacting the credit market in SSA, and how this is affecting economic growth.

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Notes

1. Yu'eobao is an internet-based fund developed by Alipay in 2013 (<http://www.thfund.com.cn/en/yuebao.html>)
2. Alipay is an eWallet app that lets users store debit or credit card details to make online and in-store purchases using their phones. It works as a mobile wallet-based payment method (<https://wise.com/us/blog/what-is-alipay>)
3. $Economic\ Effect = \frac{Standard\ Deviation_{ind\ variable} \times Regression\ Coefficient}{Standard\ Deviation_{dep\ variable}}$
4. M-Shwari is a revolutionary banking product created in partnership with M-Pesa and NCBA, which allows you to save and borrow money through your phone while earning you interest on money saved <https://ke.ncbagroup.com/m-shwari/#:~:text=M%2DShwari%20is%20a%20revolutionary,you%20interest%20on%20money%20saved.>

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Appendix 1: Correlation matrix

Variables	coredep_tl	ltd_tl	eq_tl	gdp	gvtdebt	dom_cred	inv_flows	fintech
coredep_tl	1.0000							
ltd_tl	-0.0355	1.0000						
eq_tl	0.2177*	0.0345	1.0000					
gdp	0.0261	0.0287	-0.053	1.0000				
gvtdebt	-0.0372	0.1316*	0.1801*	-0.0595	1.0000			
dom_cred	-0.0683	-0.0983	0.0724	-0.3830*	-0.1099*	1.0000		
inv_flows	0.0461	0.0048	0.1875	0.3463*	0.0532	0.0541	1.0000	
fintech	0.0571	0.2368	0.1200	-0.3641	0.5485	-0.2238	-0.0838	1.0000

NB: All variables are in log form

Appendix 2. List of countries and number of banks

	Country	Number of sampled banks	Income class
1	Angola	4	Lower middle income
2	Botswana	3	Upper middle income
3	Burkina Faso	2	Low income
4	Eswatini	1	Lower middle income
5	Ghana	7	Lower middle income
6	Ivory Coast Cote d'Ivoire)	2	Lower middle income
7	Kenya	8	Lower middle income
8	Malawi	4	Low income
9	Mali	2	Low income
10	Mauritius	2	Upper middle income
11	Namibia	2	Upper middle income
12	Niger	1	Low income
13	Nigeria	9	Lower middle income
14	Rwanda	1	Low income
15	Senegal	2	Lower middle income
16	South Africa	5	Upper middle income
17	Uganda	1	Low income
18	Zambia	2	Lower middle income
19	Zimbabwe	2	Lower middle income
	Total	56	

Source: Individual countries' central banks for the list of banks; S&P Capital IQ for the sample