FINANCIAL TECHNOLOGY AND FINANCIAL INCLUSION IN SSA: A REEXAMINATION WITH BOOTSTRAP CAUSALITY APPROACH

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Abstract

The study adopts the Dumitrescu–Hurlin panel bootstrap causality test to investigate the causal relations between Financial Technology and Financial Inclusion in a cross-section of 46 countries of Sub Sahara Africa (SSA), which includes 12 countries of the West Africa sub-region for the period 2000 and 2020. The study documents a bidirectional (two-way) causality between financial technology and financial inclusion in a cross-section of SSA countries. However, after accounting for heterogeneity, we do not find causality in either direction in most countries. Results for the West African countries contained in the panel exemplify that the relationship between these two concepts is complex, with no clear consensus on the direction of causality between them. For instance, the study finds no causality in either direction in the case of Benin, Burkina-Fasso, Gambia, Ghana, Senegal and Serra Leone. In contrast, causality runs from Financial Technology to Financial Inclusion in the Case of Guinea, Guinea Bissau, Mali and Nigeria. Liberia and Niger Republic exemplify causality running from Financial Inclusion to Financial Technology.

JEL CODE; E44; F65; G23

Key Words: Financial Technology; Financial Inclusion; Causality

1.0 Introduction

The phenomenal proliferation of the financial services landscape by financial technology (fintech) has significantly redefined how the traditional financial industry provides access to financial products and services through banks and other non-bank financial institutions. Fintech encompasses technological advancements transforming financial services such as mobile money, digital payments, peer-to-peer lending, and blockchain solutions. One of the payoffs of the digital finance revolution is its panacea to the long-standing global issue of exclusion from the financial services industry, which has been conclusively linked with slow growth and poverty incidences, particularly in developing economies. These innovations hold the prospects to expand access to formal financial services to the hitherto excluded and marginalized groups, with prospects for economic empowerment, poverty alleviation, and sustainable development.

Financial inclusion, defined as the accessibility and usage of formal financial services by all members of society, provides broad access to financial services, while obviating price and non-price impediments that are associated with traditional finance—are more likely to be of help to the poor and disadvantaged. Without inclusive financial institutions, impoverished individuals are left with limited funds to meet their investment needs for education and entrepreneurial activities. Similarly, small businesses only have little profits to explore promising development possibilities.

The relationship between financial technology (fintech) and financial inclusion is extensively explored in academic literature. Researchers like Demirgüç-Kunt et al. (2018) argue that fintech innovations can decrease barriers to accessing financial services for marginalised groups. Beck et al. (2017) suggest that fintech solutions may also lower the operational costs of delivering financial services. Allen et al. (2016) further posit that digital financial services enhance transaction efficiency, facilitating greater participation in the formal financial system by individuals and businesses. According to the World Bank (2017), improved access to financial services supports inclusive economic growth by enabling better savings, investment, and risk management opportunities for individuals.

These issues are important for Sub-Saharan Africa (SSA), which presents diverse outcomes in terms of the levels of financial depth, financial infrastructure, and inclusive finance. It is thus hoped that the emergence of fintech and its transformative force will bridge existing gaps in financial services and the unbanked or underserved populations in Sub Sahara Africa

The literature on Sub-Saharan Africa (SSA) regarding the causality between financial technology (fintech) and financial inclusion indicates growing evidence. However, findings remained mixed and inconclusive. For instance, Kanungo & Gupta, 2021 found that financial technology has barely advanced financial inclusion, while authors including Evans, 2018; Wellalage et al., 2021; Aziz & Naima, 2021; Yue et al., 2021; QuangBui et al., 2021 postulated that financial technology has paved the way for greater accessibility to financial services.

The conflicting results may be attributed to several reasons. One is that most of the previous research on the relations between financial technology and financial inclusion has adopted the traditional Granger causality framework. This method suffers some major drawbacks. The traditional Granger approach does not consider the existence of feedback effects between the two variables. Previous studies on financial technology and inclusion have assumed a one-way relationship, without considering the possibility of feedback in the relationship. This omission can obscure the direction and the causal nexus and may result in biased results.

Therefore, a more suitable econometric approach would be a panel causality framework which considers heterogeneity, endogeneity, and feedback effects in panel data.

From a policy perspective, there may be important policy implications depending on the causal relationship between these variables. (Olaoye et al., 2020). For example, if we do not find that causality runs from financial technology to financial inclusion, then financial technology assumes a passive role. However, if the causality runs from financial technology to financial inclusion, financial technology acquires a significant policy variable status. Unfortunately, empirical investigation into the direction of causation between financial technology and financial inclusion in Africa is sparse, inconclusive, and largely anecdotal (see, Ozili, 2017).

Consequently, the study examines the causative nexus between financial technology and financial inclusion across 46 countries of sub-Saharan Africa, which included 12 countries of the West African sub-region for which consistent data series were available. A preponderance of the literature has adopted the traditional Granger causality method when investigating the direction of causation between two variables. Specifically, the traditional Granger method is blind to the possible heterogeneity in panels, notwithstanding that it is essential to account for heterogeneity in the panel data framework since the individual units in a panel framework may vary in the critical parameters under consideration, i.e., level of innovations and development in the financial sector and its level of inclusiveness in this case. This research adds to the ongoing discussion on the effects of financial inclusion as a viable approach to poverty reduction in developing and impoverished countries.

The rest of the paper proceeds as follows: following this introduction, Section 2 provides a summary of the literature on financial inclusion-Fintech nexus; Section 3 examines the methodology and estimation techniques; Section 4 discusses the empirical results; and Section 5 concludes the study.

2.0 Literature Review

Financial inclusion refers to the process of ensuring that everyone, especially those who are poor, have access to essential financial services offered by official financial institutions (De Koker & Jentzsch, 2013; Evans & Alenoghena, 2017; Allen et al, 2016; Ozili, 2018). Policymakers and academics have given significant attention to financial inclusion for four primary reasons. Firstly, it is a major strategy to achieve the United Nations' sustainable development goals (Sahay et al, 2015; Demirguc-Kunt et al, 2017). Secondly, it helps to improve social inclusion levels in many societies (Bold, et al, 2012). Thirdly, it can help to reduce poverty levels to a desired minimum (Chibba, 2009; Neaime & Gaysset, 2018). Finally, it promotes overall development (Sarma & Pais, 2011; Kpodar & Andrianaivo, 2011). Policymakers worldwide continue to dedicate significant resources towards increasing financial inclusion in their respective countries to eliminate financial exclusion.

Previous research has explored different aspects of financial inclusion, such as promoting development through financial inclusion (Sarma and Pais, 2011; Ghosh, 2013), the impact of financial inclusion on financial stability (Hannig and Jansen, 2010; Cull et al, 2012), the connection between financial inclusion and economic growth (Mohan, 2006; Kim et al., 2018), country-specific financial inclusion practices (Mitton, 2008), and the relationship between financial technology and financial inclusion (Ozili, 2021; Evans, 2018; Kanungo & Gupta, 2021; Yue et al., 2021).

Moreover, some studies have focused on measuring and promoting financial inclusion and its influence on

poverty reduction, income inequality, and growth (Marshall, 2004; Sarma & Pais, 2011; Hannig and Jansen, 2010; Ardic et al., 2011; Thorat, 2006; Chibba, 2009; Kpodar & Andrianaivo, 2011; Dabla-Norris, et al., 2015; Sharma, 2016).

The link between digital finance and financial inclusion is rooted in the idea that a significant portion of the excluded population own a mobile phone and that providing financial services through mobile phones and related devices can improve access to finance for these individuals. Generally, an increase in the supply of digital finance is expected to have positive effects on financial inclusion, meaning that the usage of digital finance is associated with greater access to formal financial services. Various studies have examined the relationship between financial technology and financial inclusion in both developed and emerging economies, and the results are compelling (see Ozili, 2017; Evans, 2018; Kelikume, 2020; Wellalage et al., 2020; Senyo et al., 2020; Liu et al., 2021; Aziz & Naima, 2021; QuangBui et al., 2021; Vyas & Jain, 2021; Kanungo & Gupta, 2021; Yue et al., 2021). While some studies (e.g., Kanungo & Gupta, 2021) have found that financial technology has had little impact on advancing social and economic inclusion, others (Evans, 2018; Wellalage et al., 2020; Aziz & Naima, 2021; Yue et al., 2021; QuangBui et al., 2021) have shown that financial technology has bridged the gap between physical access to financial services and those who do not have access. These studies have produced diverse and sometimes contradictory outcomes.

The conflicting outcomes present the need for further empirical studies that seek to understand the causal nexus between the phenomenon of financial technology and inclusion, adopting methodological processes that obviate biases that may obscure the true causality structure. The Bootstrap causality approach accounts for heterogeneity, endogeneity, and feedback effect in the panel data structure, and would be a more suited econometric alternative. The current study fills the gap in the SSA literature on this topic, by employing the Dumitrescu–Hurlin (2012) panel bootstrap causality test on a panel of 46 Sub-Saharan African countries to determine the direction of causation between financial technology and financial inclusion.

3.0 Data and Methodology

The study employed a balanced panel data of 46 sub-Saharan African countries including 12 West African countries, comprising Benin Republic, Burkina-Faso, The Gambia, Ghana, Senegal and Sierra Leone. Others are Guinea, Guinea Bissau, Mali, Liberia and Niger Republic. Data availability limited the period of analysis to 2000 to 2020. Financial inclusion was measured by the number of commercial bank branches per 100,000 adults, and financial technology was measured by mobile cellular subscriptions per 100 people. The data was sourced from World Development Indicators (WDI) (World Bank, 2022).

The study adopts the innovative Dumitrescu–Hurlin (2012) panel bootstrap causality test to determine the direction of causation between financial technology and financial inclusion in a panel of 46 sub-Saharan African countries. This technique controls for heterogeneity in panel data model. The method also deals with the empirical issue of cross-sectional dependence using a bootstrap procedure.

The Dumitrescu–Hurlin panel causality test is specified as follows:

$$y_t = \alpha + \sum_{k=1}^{K} \gamma_k y_{t-k} + \sum_{k=1}^{K} \beta_k x_{t-k} + \varepsilon_t \quad with\ t = 1..., T \tag{1}$$

where x_t (in this case, financial technology, measured by mobile cellular subscription per 100 people) and y_t (in this case, financial inclusion, measured by the number of commercial bank branches per 100,000 adults) are two stationary series. We can test whether x causes y. To do this, it is common to use the F test with the following null hypothesis:

$$H_0 : \beta_1 = ... = \beta_K = 0$$

If causality is from x to y, we reject the null hypothesis (H_0). In a time series analysis, the x and y variables can be interchanged to test for causality in the other direction and for bidirectional (two-way) causality (feedback effect).

The model was extended by Dumitrescu and Hurlin (DH) (2012) to test for causality in panel data. The underlying panel specification is given as:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{i,t} \quad with\ i = 1,..., \mathrm{N}\ and\ t = 1,..., T$$

(2)

where $x_{i,t}$ and $y_{i,t}$ are the observations of the two stationary variables for individual *i* in period *t*. x is financial technology (proxied by mobile cellular subscription per 100 people), and y is financial inclusion (proxied by the number of commercial bank branches per 100,000 adults). The lag order *K* is assumed to be identical for all individuals. In the panel framework, the null hypothesis is that there is no causality for all individuals in the panel:

$$H_0 : \beta_{i1} = ... = \beta_{iK} = 0 \qquad \forall i = 1,..., N \tag{3}$$

Interestingly, The DH test can be used to investigate causality for some individual countries in the panel (Dumetriscu & Hurlin, 2012).

The DH test assumes that there is a causal relationship for certain individuals, though it may not apply to everyone. It's important to keep this in mind as it can impact the validity of the test results.

$$H_1 : \beta_{i1} = ... = \beta_{iK} = 0 \qquad \forall i = 1,..., N_1$$

$$\beta_{i1} \neq 0 \text{ or } ... \text{ or } \beta_{iK} \neq 0 \qquad \forall i = N_1 + 1,..., N$$

where N_1 ∈ [0, N − 1] is unknown. If N_1 = 0, there is causality for all individuals in the panel. N_1 must

be strictly smaller than N; otherwise, there is no causality for all individuals and H_1 reduces to H_0.

Thus, in the panel data framework, the Dumetriscu & Hurlin (2012) panel causality test performs the F tests of the K linear hypotheses $\beta_{i1} = ... = \beta_{iK} = 0$ to retrieve the individual Wald statistic W_i, and finally compute the average Wald statistic $\overline{W}$:

$$\overline{W} = \frac{1}{N}\sum_{i=1}^{N} W_i$$

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4.0 Presentation and Discussion of Results

4.1 Preliminary Analysis

Table 1: Descriptive statistics

variable	Mean	Standard deviation	Observation
Financial Technology	43.2314	36.3241	688
Financial Inclusion	6.358911	8.822019	688

Note: Financial technology is proxied by Mobile cellular subscriptions (per 100 people), and financial inclusion is captured by the number of commercial banks branches per 100,000 adults. Source: World Development Indicators (WDI) (2020).

Table 1 presents descriptive statistics for each of the Fintech and Inclusion variables employed in the study. As indicated, the panel is balanced with 688 observations, apiece. The table includes statistics such as the number of observations, mean, and standard deviation of the variables. Notably, the Fintech variable displays a standard deviation of 36.32, which is significantly higher than 8.82 for the Inclusion variable.

4.2 Test for Slope Heterogeneity

However, before estimating the causal relationship between financial technology and financial inclusion, examining the potential heterogeneity among the selected SSA countries is essential. The study used Bersvendsen and Ditzen's (2020) test for slope homogeneity. This is important because these countries might vary in their economic structure levels and the extent of the deployment of financial technology, which might result in heterogeneous slope parameters. Bersvendsen and Ditzen's (2020) test for slope homogeneity is set under the null hypothesis (H_0) that the slope coefficients are homogenous.

Table 2. Test for Slope Homogeneity

	Standard	p-value	HAC	p-value
delta	-1.944	0.052	-1.819	0.069
adj	-1.040	0.041	-1.909	0.056

Note: Standard represents the standard test for homogeneity and HAC denote test for homogeneity using heteroskedastic and serially correlated errors augmented versions respectively. The null hypothesis (H_0) is slope coefficients are homogenous.

In Table (2), the test for slope homogeneity using Bersvendsen and Ditzen's (2020) test for slope homogeneity reveals that the null hypothesis of slope homogeneity is rejected at the 5 per cent level of significance. This suggests that conclusions from previous studies on the causal relationship between financial technology and financial inclusion that ignored the possible heterogeneity in panel causality might be misleading and

fallacious. Thus, accounting for heterogeneity in the causal relationship between financial technology and financial inclusion is important. In this wise, the Dumitrescu & Hurlin (2012) panel bootstrap causality test would be a more appropriate model. Interestingly, the Dumitrescu & Hurlin (2012) panel causality framework accounts for potential heterogeneity in a panel data framework. In our case, heterogeneity may arise due to varying growth rates and differences in the level of financial technology among the selected countries. Likewise, the D-H method helps us to disentangle the direction of causation for individual countries in the panel. This is important since there can be causality for some individuals but not necessarily for all the cross-sections (see Dumitrescu & Hurlin, 2012).

Results of the Dumitrescu & Hurlin (2012) Panel Granger non-causality test with a bootstrap procedure.

Table 3: Results of Panel Granger non-causality test with a bootstrap procedure (whole Sample (Panel))

Lag order: 1		
W-bar	3.9248	
Z-bar	14.0268	(p-value* = 0.000, 95% critical value = 7.7366)
Z-bar tilde	8.8724	(p-value* = 0.000, 95% critical value = 4.5644)

H_0: Financial technology does not Granger-cause Financial inclusion
H_1: Financial technology does Granger-cause Financial inclusion for at least one panelvar (COUNTYID).
* p-values computed using 100 bootstrap replications.

H_0: Financial inclusion does not Granger-cause Financial technology

H_1: Financial inclusion does Granger-cause Financial technology for at least one panelvar (COUNTYID).

* p-values computed using 100 bootstrap replications.

The results from the panel Granger causality test (whole sample) in Table 3 show that the null hypotheses: (1) H_0 —Financial inclusion does not Granger-cause financial technology (2) H_0—financial technology does not Granger-cause financial inclusion are rejected at any conventional level of significance. This implies a bidirectional (two-way) causality between financial technology and financial inclusion in sub-Saharan African countries. That is, financial technology causes financial inclusion and vice versa. This result might have crucial practical policy implications. For example, the causality from financial technology to financial inclusion is consistent with the findings of Evans (2018) that the use of the internet and mobile phones has increased financial inclusion. Also, Taylor (2020) noted that financial technology has undoubtedly contributed to financial inclusion by expanding financial services to poorer households through low-cost digital payment services. Likewise, the study finds causality from financial inclusion to financial technology. Our result is novel in this regard. The result suggests financial inclusion can lead to more significant financial technology usage. This study is consistent with Ozili's suggestions (2017). According to the author, financial technology can promote financial inclusion and encourage greater use of digital finance platforms. This is because increased financial inclusion would make bank account holders more aware of the benefits of digital finance platforms, which can improve their financial well-being.

This result suggests that financial technology and inclusion are essential policy variable tools. Thus, African governments should deploy and expand financial finance platforms to increase financial inclusion. Similarly, African governments should deepen financial inclusion in the region to increase digital finance usage.

However, we declare a caveat in the interpretation of this result. In line with Dumetriscu and Hurlin (2012), we argue that causality for all (whole panel) may not indicate causality for individual countries and that causality for some individuals may not necessarily mean causality for all due to possible heterogeneity in the panel data model. In this milieu, the study investigates the direction of causality for an individual unit. The result is presented in Table 4.

The result in Table 4 supports the á priori and is consistent with the argument of Dumestricu and Hurlin (2012) that causality for all may not mean causality for individuals. Specifically, the results show no bidirectional (two-way) causality between financial technology and financial inclusion in all the countries. In many countries, we do not find causality in either direction, indicating that financial technology does not cause financial inclusion, and financial inclusion does not cause financial technology. While in some other countries, the result shows a unidirectional causal relationship.

Results for the West African countries contained in the panel exemplify that the relationship between these two concepts is complex, with no clear consensus on the direction of causality between them. For instance, the study finds no causality in either direction in the case of Benin, Burkina-Faso, The Gambia, Ghana, Senegal and Sierra Leone. In contrast, causality runs from Financial Technology to Financial Inclusion in the Case of Guinea, Guinea Bissau, Mali and Nigeria. Liberia and Niger Republic exemplify causality running from Financial Inclusion to Financial Technology.

Table 4 Results of Panel Granger non-causality test with a bootstrap procedure (individual countries)

Country	Wald Test	Fin.Tech → Fin.Inc	Wald Test	Fin.Incl. → Fin.Tech.Inference	
Angola	11.14 (0.006)	Yes	2.53(0.13)	No	Unidirectional
Benin	0.76(0.401)	No	1.47(.24)	No	No Causality
Botswana	0.18(0.677)	No	7.06(.022)	Yes	Unidirectional
Burkina Faso	2.56(0.137)	No	2.18(.167)	No	No Causality
Burundi	0.03(0.856)	No	5.76(.035)	Yes	Unidirectional
Cabo Verde	1.05(0.326)	No	5.93(.033)	Yes	Unidirectional
Cameroon	3.44(0.090)	No	14.35(.002)	Yes	Unidirectional
C. A. R.	0.11(0.743)	No	.022(.88)	No	No Causality
Chad	6.82(0.024)	Yes	.179(.680)	No	Unidirectional
Comoros	12.0(0.005)	Yes	.551(.473)	No	Unidirectional
Congo Dem. Rep.	15.9(0.002)	Yes	.187(.673)	No	Unidirectional
Congo	5.70(0.035)	Yes	1.03(.330)	No	Unidirectional
Cote d'Ivoire	1.310(0.270)	No	4.129(.067)	Yes	Unidirectional
Equatorial Guinea	0.050(0.82)	No	.203(.661)	No	No Causality
Eswatini	2.76(0.124)	No	.229(.641)	No	No Causality
Ethiopia	2.47(0.144)	No	.028(.869)	No	No Causality
Gabon	19.24(0.001)	Yes	.392(.543)	No	Unidirectional
Gambia, The	0 .914(0.359)	No	.228(.642)	No	No Causality
Ghana	2.10(0.174)	No	.005(.942)	No	No Causality
Guinea	6.44(0.027)	Yes	.552(.472)	No	Unidirectional
Guinea Bissau	7.47(0.019)	Yes	2.03(.181)	No	Unidirectional
Kenya	5.89(0.033)	Yes	2.64(.132)	No	Unidirectional
Lesotho	1.20(0.294)	No	4.59(.055)	Yes	Unidirectional
Liberia	1.47(0.249)	No	5.58(.037)	Yes	Unidirectional
Madagascar	0.745(0.406)	No	.0003(.98)	No	No Causality
Malawi	12.4(0.004)	Yes	.595(.456)	No	Unidirectional
Mali	6.48(0.027)	Yes	.001(.973)	No	Unidirectional
Mauritania	2.79(.122)	No	.221(.647)	No	No Causality
Mauritius	17.55(.001)	Yes	2.28(.158)	No	Unidirectional
Mozambique	1.07(0.322)	No	.750(.404)	No	No Causality
Namibia	.001(0.97)	No	.048(.830)	No	No Causality
Niger	0.208(0.655)	No	7.06(.022)	Yes	Unidirectional
Nigeria	4.75(0.05)	Yes	.425(.527)	No	Unidirectional
Rwanda	0 .041(0.84)	No	15.87(.002)	Yes	Unidirectional
Sao Tome & Prin.	2.32(0.155)	No	1.27(.282)	No	No Causality
Senegal	0.66(0.430)	No	1.29(.278)	No	No Causality
Seychelles	1.31(0.270)	No	.487(.499)	No	No Causality
Sierra Leone	.292(.599)	No	3.18(.102)	No	No Causality
South Africa	7.94(.99)	No	4.73(.052)	Yes	Unidirectional
South Sudan	5.07(.04)	Yes	.506(.491)	No	Unidirectional
Sudan	.34(.56)	No	.463(.510)	No	Unidirectional
Tanzania	5.85(.03)	Yes	3.06(.107)	No	Unidirectional
Togo	.23(.64)	No	2.62(.1330	No	No Causality
Uganda	.019(.89)	No	2.06(.178)	No	No Causality
Zambia	6.64(.025)	Yes	.025(.876)	No	Unidirectional
Zimbabwe	.42(.526)	No	.197(.665)	No	No Causality

Note: The figures in parentheses are probability values.

The conflicting results between the panel causality test for the whole sample and the individual country specification indicate that the individual units in the panel framework are heterogeneous in the level of financial technology and the extent of financial inclusion.

Notably, the conflicting results could mean that there is a threshold effect in the relationship between financial technology and financial inclusion. This is in line with the findings of Liu et al. (2021) that the development of digital financial inclusion has a significant Internet development threshold effect on economic growth. This means there is a minimum level of financial technology below which financial inclusion will not be achieved and vice versa. The foregoing remains a suggestion for further empirical inquiry.

5.0 Conclusion

The study investigates the causal relationship between financial technology and financial inclusion in a panel of 46 SSA countries using the innovative Dumestricu and Hurlin (2012) panel bootstrap causality test that accounts for heterogeneity in panel data. The results show that for the panel framework, there is a bidirectional (two-way) causality between financial technology and financial inclusion. However, we do not find evidence of bidirectional (two-way) causality after accounting for heterogeneity. In many countries, we do not find causality in either direction, indicating that financial technology does not cause financial inclusion, and financial inclusion does not cause financial technology. While in some other countries, the result shows a unidirectional causal relationship.

However, after accounting for heterogeneity among the individual countries in the panel, we find mixed results of no causality for some countries and unidirectional causality for others. This suggests that there could be a threshold effect in the relationship between financial technology and financial inclusion. One economic implication is that there is a minimum level of financial technology below which financial inclusion will not be achieved and vice versa.

Our findings may have important practical policy implications, based on the peculiarities of the findings regarding financial inclusion and technology causality in sub-Saharan African (SSA) countries: Given the bidirectional causality for all SSA countries, policymakers should focus on creating synergies between financial inclusion and technology. Encourage collaboration between financial institutions and fintech companies to enhance access to digital financial services. This is in addition to promoting financial literacy programs that educate citizens about using technology for financial transactions. This can empower individuals to make informed choices and participate actively in the financial system.

The absence of causality in certain countries calls for a tailored approach to assess the specific barriers hindering the relationship between financial inclusion and technology. Context-specific interventions, such as improving digital infrastructure, addressing regulatory gaps, and promoting trust in digital financial services.

In countries where fintech drives financial inclusion in a unidirectional manner, policymakers foster an enabling environment for fintech innovation by streamlining regulations and encouraging investment. There is a need to promote partnerships between fintech firms and traditional financial institutions to expand access to credit, savings, and payment services. This is in addition to enhancing cybersecurity measures to build trust in digital channels.

For countries where financial inclusion leads to fintech adoption, the need exists to prioritize efforts to increase financial literacy and awareness among underserved populations. Also, developing targeted policies to

promote inclusive financial services, such as mobile banking, microfinance, and community-based initiatives. In addition, encouraging fintech firms to design solutions that address the specific needs of marginalized groups, will be important

REFERENCES

Allen, F., Demirguc-Kunt, A., Klapper, L., & Peria, M. S. M. (2016). The foundations of financial inclusion: Understanding ownership and use of formal accounts. Journal of financial Intermediation, 27, 1-30.

Andrianaivo, M., & Kpodar, K. R. (2011). ICT, financial inclusion, and growth: Evidence from African countries. IMF Working Papers, 2011(073).

Ardic, O. P., Heimann, M., & Mylenko, N. (2011). Access to financial services and the financial inclusion agenda around the world: a cross-country analysis with a new data set. World Bank Policy Research Working Paper, (5537).

Aziza, A., & Naimab, U. (2021). Rethinking digital financial inclusion: Evidence from Bangladesh. Technology in Society. Available at https://doi.org/10.1016/j.techsoc.2020.101509.

Beck, T., Senbet, L., & Simbanegavi, W. (2015). Financial inclusion and innovation in Africa: An overview. Journal of African Economies, 24(suppl_1), i3-i11.

Bersvendsen, T., & Ditzen, J. (2020). xthst: Testing for slope homogeneity in Stata. Centre for Energy Economics Research and Policy, CEERP Working Paper No. 11, January 2020.

Bold, C., Porteous, D. and Rotman, S. (2012). Social cash transfers and financial inclusion: Evidence from four countries. Consultative Group for Assisting the Poor (CGAP), February 1-20.

Chibba, M. (2009). Financial inclusion, poverty reduction and the millennium development goals. The European Journal of Development Research, 21(2), 213-230.

Cull, R., Demirgüç-Kunt, A., & Lyman, T. (2012). Financial inclusion and stability: what does research show?.

Dabla-Norris, M. E., Ji, Y., Townsend, R., & Unsal, M. F. (2015). Identifying constraints to financial inclusion and their impact on GDP and inequality: A structural framework for policy. International Monetary Fund.

De Koker, L., & Jentzsch, N. (2013). Financial inclusion and financial integrity: Aligned incentives? World Development, 44, 267-280.

Della Peruta, M. (2018). Adoption of mobile money and financial inclusion: a macroeconomic approach through cluster analysis. Economics of Innovation and New Technology, 27(2), 154-173.

Demirgüç-Kunt, A., & Klapper, L. F. (2012). Financial inclusion in Africa: an overview. World Bank Policy Research Working Paper, (6088).

Demirgüç-Kunt, A., & Singer, D. (2017). Financial inclusion and inclusive growth: A review of recent empirical evidence. World Bank Policy Research Working Paper, (8040).

Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2020). The Global Findex Database 2017: Measuring financial inclusion and opportunities to expand access to and use of financial services. The World Bank Economic Review, 34(Supplement_1), S2-S8.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. Eco-

nomic Modelling, 29(4), 1450–1460.

Evans O. (2018). Connecting the poor: the internet, mobile phones and financial inclusion in Africa. Digital policy, Regulation and Governance, 20(6), 568-581.

Evans, O. L. A. N. I. Y. I., & Alenoghena, O. R. (2017). Financial inclusion and GDP per capita in Africa: A Bayesian VAR model. Journal of Economics & Sustainable Development, 8(18), 44-57.

Gai, K., Qiu, M., & Sun, X. (2018). A survey on FinTech. Journal of Network and Computer Applications, 103, 262-273.

Ghosh, J. (2013). Microfinance and the challenge of financial inclusion for development. Cambridge journal of economics, 37(6), 1203-1219.

Hannig, A., & Jansen, S. (2010). Financial inclusion and financial stability: Current policy issues.

Kanungo, R. P., & Gupta, S. (2021). Financial inclusion through digitalisation of services for well-being. Technological Forecasting & Social Change. Available at https://doi.org/10.1016/j.techfore.2021.120721.

Kelikume, I. (2020). People and Places in the Global Economy. Journal of Enterprising Communities 15(4).

Kim, D. W., Yu, J. S., & Hassan, M. K. (2018). Financial inclusion and economic growth in OIC countries. Research in International Business and Finance, 43, 1-14.

Liu, Y., Luan, L., Wu, W., Zhang, Z., Hsu, Y. (2021) Can digital financial inclusion promote China's economic growth? International Review of Financial Analysis. Available at https://doi.org/10.1016/j.irfa.2021.101889.

Marshall, J. N. (2004). Financial institutions in disadvantaged areas: a comparative analysis of policies encouraging financial inclusion in Britain and the United States. Environment and Planning A, 36(2), 241-261.

Mitton, L. (2008). Financial inclusion in the UK: Review of policy and practice. Joseph Rowntree Foundation.

Mohan, R. (2006). Economic growth, financial deepening and financial inclusion. Reserve Bank of India Bulletin, 1305.

Neaime, S., & Gaysset, I. (2018). Financial inclusion and stability in MENA: Evidence from poverty and inequality. Finance Research Letters, 24, 230-237.

Olaoye, O., & Afolabi, O. (2020). Government spending and economic growth: a trivariate causality test. African Journal of Economic and Management Studies. Available at https://doi.org/10.1108/AJEMS-07-2020-0334

Ouma, S. A., Odongo, T. M., & Were, M. (2017). Mobile financial services and financial inclusion: Is it a boon for savings mobilization? Review of development finance, 7(1), 29-35.

Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. Borsa Istanbul Review, 18 (4), 329-340.

Ozili, P. K. (2021). Financial inclusion research around the world: A review. In Forum for social economics (Vol. 50, No. 4, pp. 457-479). Routledge.

Ozili, P.K. (2017). Impact of digital finance on financial inclusion and stability. Borsa Istanbul Review, 18 (4), 329-340.

QuangBuiab, T., PhuongDo, A. V. (2021). Does technological inclusion reduce financial constraints on small and medium sized enterprises? The case of Vietnam. Journal of Finance Research Letters. Available at https://doi.org/10.1016/j.frl.2021.102534.

Rizzo, M. (2014). Digital Finance: empowering the poor via new technologies. Washington DC: The Word Bank.

Sahay, M. R., Cihak, M., N'Diaye, M. P., Barajas, M. A., Mitra, M. S., Kyobe, M. A., ... & Yousefi, M. R. (2015). Financial inclusion: can it meet multiple macroeconomic goals? International Monetary Fund.

Sarma, M., & Pais, J. (2011). Financial inclusion and development. Journal of international development, 23 (5), 613-628.

Senyo, P. K., & Osabutey, E. L. (2020). Unearthing antecedents to financial inclusion through FinTech innovations. Technovation, 98, 102155.

Sharma, D. (2016). Nexus between financial inclusion and economic growth: Evidence from the emerging Indian economy. Journal of financial economic policy.

Taylor K. (2020). Does Fintech Actually contribute to financial inclusion? Scribbr. https:// about.crunchbase.com/blog/does-fintech-actually-contribute-to-financial -inclusion/

Thorat, U. (2006). Financial inclusion and millennium development goals. RBI Bulletin, 50(2), 239-243.

Vyas, V., & Jain, P. (2021). The role of digital economy and technology adoption for financial inclusion in the Indian context. Indian Growth and Development Review, 14(3), 302-324.

Wellalage, N-H., ImranHunjra, A., Manita, R., Locke, S. M. (2021). Information communication technology and financial inclusion of innovative entrepreneurs. Technological Forecasting and Social Change, Available at https://doi.org/10.1016/j.techfore.2020.120416.

Yue, P., Korkmaz, A. G., Yin, Z., & Zhou, H. (2021). The rise of digital finance: Financial inclusion or debt trap? Finance Research Letters, 102604.

Zins, A., & Weill, L. (2016). The determinants of financial inclusion in Africa. Review of development finance, 6(1), 46-57.