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Financial inclusion and income inequality nexus: A case of Africa

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Abstract

Reducing income inequality to ensure everyone enjoys the dividend of economic growth is among the priorities in achieving Sustainable Development Goals. Recently, using an inclusive financial system as an instrument to promote inclusive growth has become a global policy priority. However, little is known about the distributional impact of multidimensional financial inclusion. Thus, we analyse the effect of multidimensional financial inclusion on income inequality using panel data for 23 African countries from 2004 to 2018. Employing endogenous panel threshold model, we demonstrate that only a higher degree of financial inclusion has a favourable distributional effect. Using panel quantile regression, we find that pronounced, favourable distributional impacts of financial inclusion are observed in the higher inequality quantiles. We further demonstrate that the favourable distributional impact of financial inclusion is pronounced in the presence of a higher institutional quality. Our results are robust to several sensitivity analyses, such as instrumental variables, Bayesian model averaging, sub-sampling, and alternative measurement of income inequality. Our results highlight that promoting inclusive financial system is essential for reducing income inequality, thereby achieving inclusive economic growth. The results also imply that promoting institutional quality is essential for people to enjoy the pronounced distributional impacts of financial inclusion.

Keywords: Income inequality; Financial inclusion; Institutional quality; Africa
JEL Classification: D31; D63; G21; O55

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1. Introduction

The importance of inclusive economic growth, where every segment of a population benefit from the dividend of growth, is increasingly receiving consensus globally (Bigsten, 2016; Fosu, 2017). To achieve inclusive economic growth, it is vital that policymakers design and implement policies that reduce income inequality. To this end, Sustainable Development Goals[2] (SDGs), which are built on the successes of Millennium Development Goals while including new areas, focus on reducing inequality among other goals. Specifically, SDG10 aims to reduce inequality within and among countries. Policymakers have recently emphasised the importance of inclusive financial systems; for example, the Alliance for Financial Inclusion was founded in 2008 to advance the development of financial inclusion policies in developing and emerging economies, and Global Partnership for Financial Inclusion was founded in 2010 to advance the cause of achieving inclusive financial systems globally (Kabakova & Plaksenkov, 2018). Inclusive financial systems enable broad access to financial services without price and non-price barriers and potentially contain benefits for the poor and disadvantaged groups of a population (Park & Mercado, 2018; Zhang & Posso, 2019). These groups of a population must rely on their own limited savings and earnings to invest in their education and entrepreneurship in the absence of an inclusive financial system. In this regard, non-inclusive financial systems contribute to persistence of income inequality (Demirguc-Kunt & Klapper, 2012).

Africa witnessed strong economic performance over the past two decades, and this phenomenon led to the renowned narrative of "Africa rising". Regrettably, Africa's growth story has not been pro-poor populations, contrary to expectations that this fast growth would benefit the poor. Consequently, income inequality has remained high implying that the strong growth has been disproportionately enjoyed by wealthy sections of society, thereby widening income inequality (Meniago & Asongu, 2018). This situation— where economic growth is rising but not inclusive— is a major concern for policymakers and other stakeholders. Africa also performs worse compared to other developing regions in terms of financial inclusion (Beck et al., 2015; Demirguc-Kunt et al., 2015; Chikalipah, 2017). This bleak outlook remains even though African financial institutions have undertaken reforms, such as financial liberalisation and institutional and regulatory upgrades, to encourage the role of private sector in the financial sector, which was formerly dominated by state-owned banks and subject to restrictive regulations.

Limited studies, using solely a few indicators of financial inclusion, have analysed whether financial inclusion can be used as an instrument to reduce income inequality; for example,

[2] Details of Sustainable Development Goals can be found here: http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

Mookerjee and Kalipioni (2010) used number of bank branches per 100,000 adults on income inequality, and Neaime and Gaysset (2018) used number of bank branches and ATMs per 100,000 adults as a measurement for financial inclusion. Given that financial inclusion comprises several dimensions such as financial outreach and usage, relying solely on limited indicators cannot comprehensively capture financial inclusion and its effect on income inequality. In this regard, we are not aware of studies related to the effect of multidimensional financial inclusion on income inequality in Africa. Motivated by the gap in the literature, in this study, we aim to examine the effect of multidimensional financial inclusion on income inequality using panel data for 23 African countries from 2004 to 2018. This study incrementally contributes to the literature in several ways. First, we developed multidimensional financial inclusion index and examined its effect on income inequality for the first time in the context of Africa. Second, applying novel panel quantile regression model, we investigated whether the effect of financial inclusion varies across income inequality quantiles. Third, employing endogenous panel threshold model, we scrutinized whether financial inclusion has threshold effect on income inequality. Fourth, we analysed whether the effect of financial inclusion on income inequality depends on institutional quality. Last, the study contributes to the determinants of income inequality in general and in the context of Africa in particular.

Our overall result shows that financial inclusion reduces income inequality. Using the novel panel quantile regression, we demonstrated that the favourable distributional impact of financial inclusion is pronounced in higher inequality quantiles. Employing endogenous panel threshold model, we found that the favourable distributional effect is observed only at a higher degree of financial inclusion. We further demonstrated that the favourable distributional impact of financial inclusion is pronounced under higher institutional quality. The results highlight that inclusive financial system is crucial for reducing income inequality, thereby achieving inclusive economic growth. The results also imply that promoting institutional quality is essential for people to enjoy pronounced distributional impacts of financial inclusion. The results further suggest the importance of scrutiny for non-linear nexus of financial inclusion and income inequality studies.

The rest of the paper is structured as follows: Section 2 reviews the literature and develops hypotheses. Section 3 presents data and methodology. Section 4 presents the empirical results and discussion. Section 5 concludes the discussions and draws policy implications.

2. The literature reviews and hypotheses development

The literature related to financial services and income inequality nexus contains mixed findings. Some contend that financial development positively impacts income distribution. Given that poor populations have no sound collateral and credit history, they are negatively impacted by market

imperfections such as information asymmetry, contract enforcement, and transaction costs. These problems inhibit them from easily accessing funds; financial development, in this regard, relaxes the credit constraints experienced by poor populations and provides them with access to finances that, in turn, enable them to invest in their human and physical capital (e.g., Demirguc-Kunt & Levine, 2009). Consequently, financial development reduces income inequality by widening availability of credit to poor population. Using panel data of 126 countries from 1963–2002, Hamori and Hashiguchi (2012) showed that financial development reduces income inequality. Meniago and Asongu (2018), employing panel data of 48 African countries from 1996–2014, demonstrated that financial development[3] reduces income inequality.

Other studies, however, show that financial development exacerbates income inequality. The argument is that poor population rely mostly on informal networks of credit sources, such as family connections, for access to capital due to their deficiencies in collateral and social connections. In other words, rich population are better equipped to exploit opportunities related to financial development, and consequently triggering a higher increase in income for wealthy people than for poorer people, thereby widening the income gap (Oechslin, 2009). Jauch and Watzka (2016), using panel data of 138 countries from 1960 to 2008, found that financial development widens income inequality. Some findings have also shown that financial development does not significantly affect income distribution. Using 45 countries' panel data from 1987–2011, Seven and Coskun (2016) found that financial development does not affect income inequality.

The literature also shows that the distributional impact of financial development depends on whether it operates on extensive or intensive margin (Demirguc-Kunt & Levine, 2009). By lowering the fixed costs of accessing financial services, facilitating entrepreneurship for people with promising ideas but little to no collateral, and smoothing access to risk management, financial development that operates on extensive margin disproportionally benefits the poor and reduces income inequality. On the contrary, financial development that operates on intensive margin reduces equality of opportunity because it improves financial services available to the rich and well-established firms. Consequently, it perpetuates the relative income inequality between groups and widens the existing income gap.

[3] They used economic financial depth (money supply(M2)/GDP), financial system depth (liquid liabilities/GDP), banking system efficiency (bank credit on bank deposits), financial system efficiency (financial credit on financial deposits), banking system activity (private domestic credit from deposit banks/GDP), financial system activity (private domestic credit from financial institutions/ GDP), financial stability (prediction of the likelihood that a bank might survive and not go bankrupt using z-score) as proxies of financial development.

H1: Financial inclusion reduces income inequality.

The effect of financial development on income inequality can also depend on the level of financial development triggering a possible non-linear relationship between them. According to Aghion and Bolton (1997), moral hazard in the presence of wealth constraints on the part of borrowers is a source of both capital market imperfections and the emergence of persistent income inequalities. Accordingly, the process of capital accumulation initially widens income inequality but in later stages reduces income inequality, generating the Kuznets curve. Accordingly, different regimes of financial development impact income inequality differently. Kim and Lin (2011) showed a non-linear finance–income inequality nexus implying that financial development differently impacts inequality under regimes of financial development. Liu et al. (2017) demonstrated non-linear relationship between finance and income inequality.

H2a: Lower-degree financial inclusion increases income inequality.

H2b: Higher-degree financial inclusion reduces income inequality.

In the presence of information asymmetry, financial market imperfections and failures, economic agents with opaque information, poor collateral and credit history are excluded from accessing financial services such as credit. Under such circumstances, firms and households with better credit history and collateral disproportionally benefit from financial services such as credit, leading to a persistent (or increased) income gap in an economy. The literature shows asymmetric information is rampant in countries experiencing poor institutional quality compared to those with better-quality institutions (Marcelin & Mathur, 2014); and in countries with weak institutions, firms that are politically connected receive preferential access to credit (Khwaja & Mian, 2005). It is further established in the literature that institutions delivering better legal rights, judicial process and independence, and rule of law demonstrate the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders.

Thus, quality institution eases lending and plays a decisive role in improving financial inclusion by reducing information asymmetry, cost of access to credit, and preferential access to credit (Rajan & Zingales, 2003; Baltagi et al., 2009; Oechslin, 2009; Huang, 2010; Yang, 2011; Fowowe, 2014; Allen et al., 2016). In weak institutions, on the contrary, firms and households that are politically connected, and with better collateral and credit history, disproportionally enjoy the benefit of financial services such as credit, triggering the persistence (or increment) of income inequality. Hence, we hypothesise that the financial inclusion impact on income inequality depends on institutional quality.

H3. The effect of financial inclusion on income inequality depends on institutional quality.

The empirical studies on the finance–inequality nexus mainly focused on financial development. However, financial inclusion is different from financial development. Financial development focuses on aggregate variables such as total deposit, credit, and broad money to GDP ratio. The notion of financial inclusion, however, focuses on various dimensions of financial services for portions of populations that have been historically excluded from formal financial sectors, either because of their income level, income volatility, gender, location, type of activity, or level of financial literacy (Demirguc-Kunt & Klapper, 2012). Moreover, financial inclusion focuses on mitigating involuntary financial exclusion that arises from insufficient income, high-risk profile, discrimination, and financial market imperfections and failures (Mialou et al., 2017).

Few studies have used only a few indicators of financial inclusion to analyze the relationship between finance and income inequality. Mookerjee and Kalipioni (2010), using the number of bank branches per 100,000 people as a measurement of financial inclusion, averaged the 2000–2005 data for 65 countries and demonstrated that financial inclusion reduces income inequality. Neaime and Gaysset (2018), measuring financial inclusion by number of bank branches and ATMs per 100,000 adults, and using panel data for eight Middle East and North African countries from 2002 to 2015, demonstrated that financial inclusion reduces income inequality. These studies used only a few indicators of financial inclusion. However, the notion of financial inclusion is multidimensional and consists of physical and demographic outreaches and of usage. Therefore, using only a few indicators cannot comprehensively capture financial inclusion and its nexus with income inequality. As such, it is vital to develop a multidimensional measurement of financial inclusion and examine its impact on income inequality, a feature that is missing in the literature. We are not aware of studies that examine the effect of multidimensionally measured financial inclusion on income inequality particularly in the context of Africa.

3. Data and methodology

3.1. Data

In this study, we used panel data for 23 African countries from 2004 to 2018. The starting period was dictated by availability of data on financial inclusion indicators. Moreover, data for many of financial inclusion indicators and income inequality is available only until 2018 for the countries under consideration. Therefore, the sample is limited to the duration and countries for which data are available.

We obtained the data from a number of sources. Data for income inequality is from The Standardized World Income Inequality Database (SWIID), 2020. Financial inclusion indicators are obtained from Financial Access Survey (FAS), 2020. The remaining variables are from World Development Indicators (WDI), 2020; Fraser Institute, 2020; and United Nations Development

Program (UNDP), 2020. Table A1, in the appendix, gives a brief definition of the variables and their respective data sources.

3.2. Income inequality

Income inequality is considered from different perspectives. One viewpoint is inequality related to a functional distribution that involves the returns of factors of production such as wage, profit, and interest. The other possible perspective is considering inequality from income distribution that maps a given population into earned income or owned asset. Inequality can also be considered by decomposing it into inequality induced by circumstances beyond the control of the individual, that is, inequality of opportunity, and inequality induced by factors within the bounds of the individual choices such as individual efforts (Shimeles & Nabassaga, 2018). Moreover, the notion of income inequality may capture the intergenerational inequality dimension that deals with whether and how inequality evolves over generations and whether children from poor families remain poor or their income converges to the income of children from rich families over time (Demirguc-Kunt & Levine, 2009).

The current study does not capture inequality of opportunity and intergenerational inequality due to data unavailability for the countries and duration under consideration. Consequently, we used income inequality measured by GINI disposable index, which is adjusted to tax and transfer, for which data is available. GINI coefficient measures distribution of income on a scale of 0 to 1 (100%). The higher the GINI coefficient, the higher the income inequality. Therefore, the higher the GINI, the more unequally distributed the income is, and the lower the GINI, the more inclusive the economy is in terms of income distribution.

3.4. Financial inclusion

The notion of financial inclusion is multidimensional: some dimensions capture the supply side of finance, others capture the demand side, while some others simultaneously capture both these sides (Demirguc-Kunt & Klapper, 2012). Thus, a comprehensive understanding of financial inclusion requires capturing the various dimensions of financial services specifically focusing on portions of a population that have been historically excluded from the formal financial sector. We can consider financial inclusion from the (voluntary and involuntary) financial exclusion viewpoint. Voluntary financial exclusion occurs when some populations or firms choose not to use financial services because they have no need for them, due to reasons such as cultural and religious, while involuntary financial exclusion arises due to barriers such as insufficient income, high risk profile, discrimination, and financial market imperfections and failures (Mialou et al., 2017). To achieve an inclusive financial system, it is essential that governments and other

stakeholders address involuntary financial exclusion, which is a barrier to financial inclusion, through developing and implementing policies that enhance income of poor population and tackle problems related to financial market imperfections and failures[4]. Following the literature (Sarma & Pais, 2011; Ahamed & Mallick, 2019; Kebede et al., 2021a), we define financial inclusion multidimensionally as all the initiatives that make formal financial services available, accessible, and usable for all populations.

Following Ahamed and Mallick (2019), Ahamed et al. (2021) and Kebede et al. (2021b), we employed two stage principal component analysis (PCA) to multidimensionally index financial inclusion as follows:

$$FII = \sum_{i=1}^{n} W_{ij} X_i \quad (1)$$

where W_{ij} is the factor loading and X_i is the original indicator of financial inclusion. Before indexing, we normalised the indicators to make their scales of measurement irrelevant. In the first stage PCA, we indexed financial outreach and usage dimensions. Financial outreach dimension captures demographic and geographic subdimensions. Number of bank branches and ATMs per 100,000 adults denote demographic outreach whereas number of bank branches and ATMs per 1,000 km^2 measure geographic penetration. We indexed usage dimension from number of deposit accounts with commercial banks per 1,000 adults, depositors with commercial banks per 1,000 adults, and domestic credit to private sector by banks (% of GDP). In the second stage PCA, we indexed the overall financial inclusion from financial outreach and usage dimensions developed in the first stage PCA. Multidimensional measurement of financial inclusion enables us to analyse the effects of its dimensions, and of the overall index on income inequality, and tackle multicollinearity and overparameterization problems.

The result of indexing financial outreach dimension shows that the first principal component (PC) that explains 74.3% of the variation in the data is the only PC with eigen value greater than one, 2.9717; the remaining three PCs each have eigen value less than one. Following the literature (Ahamed & Mallick, 2019; Ahamed et al., 2021), we used the PC whose eigen value is greater than one to index the outreach dimension. Accordingly, we calculated the financial outreach dimension using the weights attached to the first PC (0.4989, 0.5057, 0.5060, and 0.4892 associated, respectively, with the number of ATMs per 100,000 adults, number of ATMs per 1,000 km^2, number of bank branches per 100,000 adults, and number of bank branches per 1,000 km^2). We indexed the usage dimension using the first PC that explains 78.09% of the data because

[4] See Mialou et al. (2017) for the details of financial exclusion.

it is the only one with eigen value greater than one, 2.3426. Accordingly, we used weights attached to the first PC (0.6220, 0.5649, and 0.5423 associated with the number of accounts with commercial banks per 1,000 adults, the number of depositors with commercial banks per 1,000 adults, and the domestic credit to private sector by banks (% of GDP), respectively. The second stage PCA—of indexing of the overall financial inclusion, from financial outreach and usage dimensions, indexed in the first stage PCA—result shows that only the first PC that explains 89.81% of the data is with eigen value greater than one, 1.7962. From the first PC, we found that equal weights of 0.7071 are assigned to the financial outreach and usage dimensions of financial inclusion. Figure 1 presents the evolution of financial inclusion in African countries under consideration from 2004–2018.

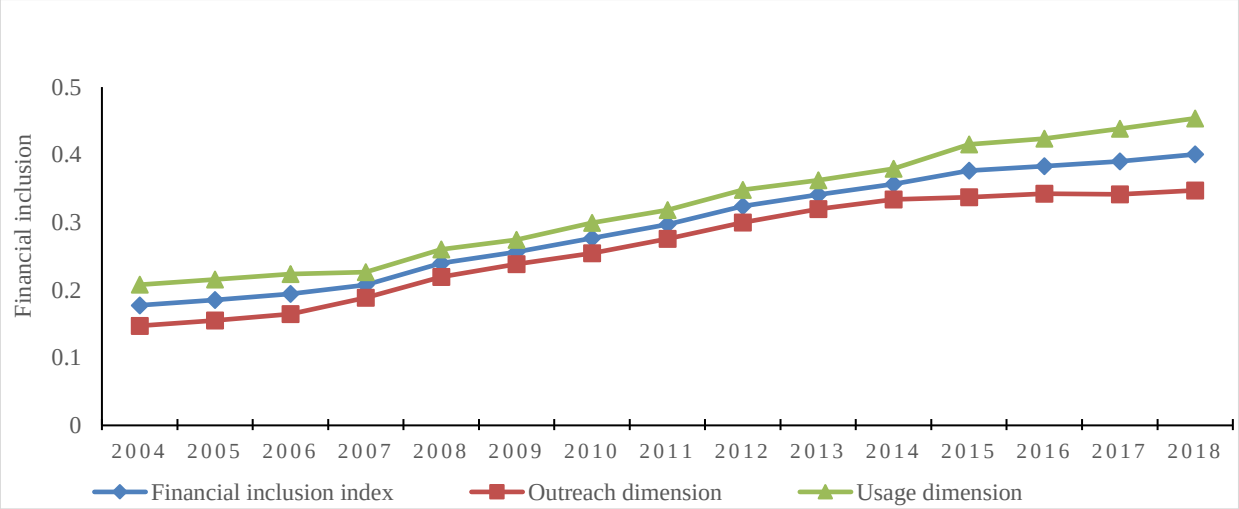

Figure 1. Evolution of financial inclusion in Africa, 2004–2018.

Table 1 summarizes the mean of the main variables for the African countries over the period 2004–2018. Column 2 shows that Namibia, Eswatini, and Botswana suffer the highest income inequality measured by GINI disposable[5] while Mauritius, Burundi, and Guinea enjoy the most favourable income distribution. Colum 3 shows that Seychelles, Mauritius, and Namibia have the most inclusive financial system measured by financial inclusion index while Congo Dem. Reb., Guinea, Madagascar have the least. Columns 4 shows that Seychelles, Mauritius and Eswatini have the highest outreach dimension while Congo Dem. Rep., Madagascar and Guinea have the least. The last column shows that Mauritius, Seychelles, and Namibia have the highest usage dimension while Congo Dem. Rep., Guinea, and Madagascar have the least.

[5] We used GINI market as a robustness check in Section 4.5.2. In terms of GINI market, Namibia, Botswana, and Zambia experience the highest income inequality while Mauritius, Tanzania and Burundi have the least income inequality.

Table 1

Sample mean of the main variables by country (2004–2018)

Country	GINI disposable	Overall FII	Outreach	Usage
(1)	(2)	(3)	(4)	(5)
Angola	0.499	0.279	0.221	0.337
Botswana	0.582	0.490	0.345	0.634
Burundi	0.391	0.112	0.130	0.094
Cameroon	0.452	0.054	0.033	0.075
Comoros	0.548	0.152	0.221	0.083
Congo, Dem. Rep.	0.439	0.004	0.002	0.006
Egypt	0.418	0.381	0.249	0.513
Eswatini	0.587	0.486	0.466	0.506
Ghana	0.434	0.299	0.250	0.349
Guinea	0.400	0.028	0.026	0.031
Kenya	0.465	0.390	0.185	0.594
Lesotho	0.502	0.226	0.163	0.289
Madagascar	0.439	0.041	0.024	0.059
Malawi	0.459	0.138	0.115	0.161
Mauritius	0.381	0.903	0.993	0.812
Namibia	0.664	0.577	0.435	0.718
Nigeria	0.433	0.400	0.386	0.414
Rwanda	0.510	0.278	0.365	0.191
Seychelles	0.428	0.903	0.995	0.812
Tanzania	0.411	0.126	0.067	0.184
Uganda	0.448	0.142	0.115	0.168
Zambia	0.556	0.131	0.113	0.148
Zimbabwe	0.472	0.217	0.181	0.254

Note: This table presents the mean value of the main variables for each country over the period 2004-2018.

3.4. Empirical model

We start with a baseline model specification in panel data setting as follows:

$$\mathrm{GINI}_{it} = \alpha o + \beta_1 \mathrm{FI}_{it} + \mathbf{X'}_{it}\gamma + \alpha_i + \varepsilon_{it}, i=1, 2, ..., N; t=1, 2, ..., T \quad (2)$$

where N and T denote number of countries and years, respectively. GINI_{it}, FI_{it}, $\mathbf{X'}_{it}$ and ε_{it} are the GINI disposable, financial inclusion index (overall, outreach dimension or usage dimension), a vector of control variables, and error term of country i at time t, respectively. α_i is individual fixed effect.

Following the literature, we controlled for potential determinants of income inequality. We included GDP per capita because it is theoretically established and empirically supported as one of the determinants of income inequality. However, whether economic growth positively, or negatively, or nonlinearly impacts income inequality is not yet settled (Kuznets, 1955; Rubin & Dan Segal, 2015). Studies also show that economic growth has no effect on income inequality (Seven & Coskun, 2016). Inflation is one of the determinants of income inequality. It is generally

understood that inflation, being a proxy for overall macroeconomic stability, differently impacts income of different groups in a country depending on their income sources. Accordingly, inflation widens income inequality if it disproportionately and negatively affects a lower income group more than a higher income group (Meniago & Asongu, 2018).

We controlled for openness, proxied by international trade to GDP ratio, because income inequality depends on the openness of a country to the rest of the world economy (Rajan & Zingales, 2003). Cabral (2016) argued that openness exacerbates income inequality in a country because it disproportionally benefits the high-income population segments over the low-income segments. We also controlled for remittance because it impacts income distribution while its effect depends on whether a majority of migrating people come from the lower-, middle-, or upper-income sections of society (Vacaflores, 2018) and whether remittance is used for consumption or investment (Bang et al., 2016).

Government expenditure, primarily spent on public and quasi-public goods that potentially benefit the poor, impacts income inequality in several ways (Muinelo-Gallo & Roca-Sagales, 2013). Government expenditure, if pro-poor, disproportionately benefits low-income groups and reduces inequality; however, it exacerbates income inequality if disproportionately spent on sectors targeting the high-income groups (Odusola, 2017). We included natural resource rent because it impacts income inequality while its effect is conditional on whether rent from resource disproportionally benefits the low-income, or the rich, and the politically connected (Carmignani, 2013; Kim & Lin, 2018). Several studies have found that urbanization, which partly explains the socio-economic structure of a country, impacts income inequality (see e.g., Liu et al., 2017).

Education, as a proxy for human capital, is one of the determinants of income inequality; earlier studies focused on two distinct distributional aspects: the "composition effect" and the "compression effect" (Knight & Sabot, 1983). The composition effect increases the number of educated people and hence initially raises—but eventually reduces—income inequality. On the other hand, the compression effect reduces income inequality because the return on education falls as the relative supply of educated people increases compared to the demand for educated people. Therefore, the net effect of education on income inequality depends on the relative strength of these two effects. Education impact on income inequality also depends on relative distribution of income among factors of production (physical, human, and financial capital) owners (Demirguc-Kunt & Levine, 2009). Empirical literature related to the effect of education on income inequality is also mixed (Qazi et al., 2018).

4. Results and discussions

4.1. Baseline result

We employed fixed effect (FE) as a baseline estimation strategy to analyse the impact of financial inclusion on income inequality[6]. We estimated Equation (2) for three cases: for overall financial inclusion index, outreach dimension, and usage dimension. Table 2 presents the baseline FE results. Column 2 presents the effect of overall financial inclusion index on income inequality. The result shows that financial inclusion significantly reduces income inequality. As discussed in Section 3, financial inclusion is a composite index of financial outreach that captures geographic and demographic penetration of the banking industry, and usage dimension which denotes deposit and credit aspects of financial services. As discussed in Section 2, the distributional effect of financial service potentially depends on the dimension of financial inclusion under consideration (Demirguc-Kunt & Levine, 2009). Thus, it is plausible that these dimensions have differential impact on income distribution. Therefore, we scrutinised whether they impact income distribution differently. Column (3) shows that the outreach impact on income inequality is qualitatively similar with that of financial inclusion index: outreach favourably impacts income distribution. The last column shows that usage dimension also reduces income inequality.

In summary, the results show that financial inclusion reduces income inequality. The results are qualitatively similar for financial outreach and usage dimensions as that of financial inclusion index. Financial inclusion reduces income inequality through several channels, such as relaxing the credit constraints experienced by low-income households. Poor households, due to their poor credit history and owning little to no collateral, disproportionately suffer from the negative impacts of financial market imperfections and failures associated with information asymmetry, contract enforcement problem, and transaction costs (Demirguc-Kunt & Levine, 2009). By relaxing credit constraints of the poor, financial inclusion enhances their access to finance and enables them to meet their needs, such as investing in physical and human capital.

[6] We have undertaken Hausman model specification to determine whether fixed effect (FE) or random effect (RE) is the appropriate model for estimation strategy. Null hypothesis of Hausman specification test is that the country time invariant characteristics is random and hence not correlated with the time variant regressors, implying RE is preferred to FE. Under the alternative hypothesis, time invariant country-specific effect is non-random and hence correlated with time variant regressors (meaning there is endogeneity problem). In this case, RE estimator is not consistent; and hence we prefer FE, which yields consistent estimator. The Hausman specification test result shows that we reject the null of using RE at the 1% significance level in favor of using FE.

Table 2

Baseline model estimation results.

Variables	Overall FII	Outreach	Usage
(1)	(2)	(3)	(4)
FI_j	-0.0119***	-0.0080**	-0.0078***
	(0.0034)	(0.0032)	(0.0025)
GDP growth	-0.0002**	-0.0001**	-0.0002**
	(0.0001)	(0.0001)	(0.0001)
GDP per capita	0.0007	0.0005	0.0010**
	(0.0005)	(0.0005)	(0.0005)
Education	0.0066	0.0072	0.0098
	(0.0134)	(0.0136)	(0.0134)
Inflation	0.0036**	0.0039**	0.0035*
	(0.0018)	(0.0018)	(0.0018)
Government expenditure	0.0072	0.0052	0.0081
	(0.0071)	(0.0071)	(0.0071)
Natural resource	-0.0025	-0.0009	-0.0012
	(0.0058)	(0.0058)	(0.0057)
Remittance	0.0637***	0.0631***	0.0619***
	(0.0105)	(0.0106)	(0.0105)
Trade	-0.0092***	-0.0086***	-0.0092***
	(0.0019)	(0.0019)	(0.0019)
Urbanization	0.0117	-0.0039	0.0207
	(0.0138)	(0.0139)	(0.0148)
Constant	0.4750***	0.4790***	0.4690***
	(0.0087)	(0.0091)	(0.0088)
Observations	345	345	345
R-squared	0.227	0.211	0.220
Number of countries	23	23	23
Year fixed effect	Yes	Yes	Yes

Note: This table presents fixed effect regression result of Eq (2), representing the impacts of overall financial inclusion index, outreach, and usage dimensions on income inequality (measured by GINI disposable) in columns 1, 2 and 3, respectively. Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

5.2. Does the effect of financial inclusion vary across quantiles of income inequality?

The baseline model given in equation (2) assumes that the impact of financial inclusion is identical across all levels of income inequality. Specifically, the baseline fixed effect result hides the information regarding whether the effect of financial inclusion on income inequality varies across various levels of income inequality, because fixed effect result is based on mean values. However, differential impacts of financial inclusion may be possible across lower and upper quantiles of income inequality. Thus, it is essential to scrutinise whether the effect of financial inclusion differs across quantiles of income inequality. To this end, we employ the panel quantile regression following Machado and Silva (2019). Given the panel data $\{(\mathrm{GINI}_{it}, X'_{it})\}$, we considered estimation of the conditional quantiles $Q_{GINI}(\tau/X_{it})$ for a location-scale model of the following form:

$$GINI_{it} = \alpha_i + \mathbf{X}'_{it}\gamma + (\delta_i + \mathbf{Z}'_{it}\lambda)\, U_{it} \quad (3)$$

where the parameters $(\alpha_i + \delta_i)$, i = 1,…, N, capture the individual i fixed effects, and $\mathbf{Z}$ is defined as a vector of known differentiable transformations of the components of X[7]; $\boldsymbol{\gamma}$ and $\boldsymbol{\lambda}$ are vectors of unknown parameters. U_{it} is an unobserved random variable, independent of X_{it}, with density function $f_u(.)$ and normalized to satisfy the moment conditions: $E(U_{it}) = 0$ and $E(|U_{it}|) = 1$. Equation 3 implies that[8]:

$$QGINI(\tau / X_{it}) = \alpha_i + \mathbf{X}'_{it}\gamma + (\delta_i + \mathbf{Z}'_{it}\lambda)\, q(\tau) \quad (4)$$

Equation 4 can further be written as follows:

$$QGINI(\tau / X_{it}) = \alpha_i(\tau) + \mathbf{X}'_{it}\gamma + \mathbf{Z}'_{it}\lambda\, q(\tau) \quad (5)$$

where $\alpha_i(\tau) = \alpha_i + \delta_i q(\tau)$ is the quantile-τ fixed effect for individual i.

Table 3 presents the quantile regression estimation results.[9] We consider the quantiles at τ =0.1, τ =0.25, τ =0.5, τ =0.75 and τ =0.9 where the lower (higher) quantiles represent lower (higher) income inequality in an economy. In other words, the lower the quantile, the more inclusive the income distribution; the higher the quantile, the more unfavourably distributed the income. Put differently, τ =0.1 represents relatively the most equally distributed income, whereas τ =0.9 represents an economy where income distribution is highly skewed towards the high-income group.

Panel A of Table 3 presents the results related to the effect of overall financial inclusion on income inequality. The result shows that financial inclusion has more favourable distributional effect where income is more unequally distributed. This shows that financial inclusion reduces income inequality more in higher income inequality quantiles. Panels B and C present the quantile regression results associated with outreach and usage dimensions, respectively[10]. Panel B shows that financial outreach significantly reduces income inequality only at τ =0.25. The impact of usage dimension, as given in Panel C, on income inequality is qualitatively similar with that of financial inclusion index although significant only at τ =0.5, τ =0.75, and τ =0.9: usage dimension has a higher favourable distributional effect at higher quantiles of income inequality.

The results show that financial inclusion disproportionately serves as an instrument of reducing income inequality where inequality is higher. The result is intuitive because in countries

[7] Assuming X and Z have the same dimensions, transformations of the components X of with element l can be given as: $Z_l = £_l(X)$, l = 1, …., k. The sequence $\{X_{it}\}$ is strictly exogenous, i.i.d for any fixed i, and independent across i. U_{it} are i.i.d, across i and t, statistically independent of X_{it}.

[8] When $q(\tau) = F_U^{-1}(\tau)$, and hence Pr $(U < q(\tau)) = \tau$.

[9] The result reported is for model with time trend. Results without time trend is not reported here; however, it does not change the result qualitatively.

[10] We have not reported the results of related control variables due to space limit. The results are available on request.

where income inequality is high, in the absence of financial inclusion, the rich and politically connected possibly enjoy the benefit of financial services, thereby exacerbating the problem of inequality. If financial inclusion is promoted, its marginal effect in reducing income inequality in such economies is higher than that of economies enjoying relatively favourable income distribution.

4.3. Does financial inclusion threshold matter?

The baseline model given in equation (2) assumes that the effect of financial inclusion on income inequality is homogeneous across different degree of financial inclusion. However, there exists a potential for nonlinear financial inclusion and income inequality nexus. The literature indicates a possible nonmonotonic relationship between income inequality and financial services such as credit (Greenwod & Jovanovic, 1990). According to Aghion and Bolton (1997), moral hazard in the presence of wealth constraints on the part of borrowers is a source of both capital market imperfections and emergence of persistent income inequalities. Accordingly, capital accumulation process initially widens income inequality; in later stages, however, it reduces income inequality, generating the Kuznets curve. Therefore, regimes of financial services potentially lead to different distributional effects.

To examine for the presence of nonlinear effect of financial inclusion on income inequality, we employed an endogenous panel threshold estimation strategy following Wang (2015) that was developed based on Hansen (1999) panel threshold model as follows:

$$GINI_{it} = \beta_1 FI_{it} I(q_i \leq \theta) + \beta_2 FI_{it} I(q_i > \theta) + \mathbf{X'}_{it}\boldsymbol{\gamma_1} I(q_i \leq \theta) + \mathbf{X'}_{it}\boldsymbol{\gamma_2} I(q_i > \theta) + \alpha_i + \varepsilon_{it} \quad (6)$$

where I(.) is an indicator function that takes the value 1 if the argument in parenthesis is valid, and 0 otherwise. q_i is threshold variable, threshold level of financial inclusion, used to split the data into different regimes of financial inclusion. The threshold parameter is $\theta \in \Phi$; where Φ is strict subset of the support of q_i.

Table 3

Panel quantile regression model estimation results.

Variables	τ =0.1	τ =0.25	τ =0.5	τ =0.75	τ =0.9
(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Overall FII					
Overall FII	-0.0074	-0.0090**	-0.0123***	-0.0147***	-0.0168***
	(0.0059)	(0.0045)	(0.0032)	(0.0042)	(0.0059)
GDP growth	-0.0001	-0.0001	-0.0001**	-0.0002**	-0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
GDP per capita	0.0006	0.0006	0.0006	0.0005	0.0005
	(0.0007)	(0.0006)	(0.0004)	(0.0005)	(0.0007)
Education	0.0102	0.0074	0.0019	-0.0021	-0.0056
	(0.0175)	(0.0134)	(0.0094)	(0.0125)	(0.0176)
Inflation	0.0024	0.0027	0.0035	0.0040	0.0045
	(0.0047)	(0.0036)	(0.0025)	(0.0034)	(0.0048)
Government expenditure	0.0049	0.0050	0.0052	0.0054	0.0055
	(0.0148)	(0.0114)	(0.0079)	(0.0106)	(0.0149)
Natural resource	0.0047	0.0026	-0.0016	-0.0047	-0.0074
	(0.0110)	(0.0084)	(0.0059)	(0.0079)	(0.0110)
Remittance	0.0614***	0.0608***	0.0595***	0.0587***	0.0579***
	(0.0180)	(0.0138)	(0.0096)	(0.0129)	(0.0181)
Trade	-0.0068*	-0.0072**	-0.0079***	-0.0085***	-0.0090**
	(0.0039)	(0.0030)	(0.0021)	(0.0028)	(0.0039)
Urbanization	-0.0333	0.0213	0.0027	0.0203	0.0352
	(0.0252)	(0.0192)	(0.0136)	(0.0179)	(0.0253)
Observations	345	345	345	345	345
Panel B: Outreach					
Outreach	-0.0060	-0.0068*	-0.0081	-0.0093	-0.0101
	(0.0073)	(0.0036)	(0.0139)	(0.0240)	(0.0313)
All control variables	Yes	Yes	Yes	Yes	Yes
Observations	345	345	345	345	345
Panel C: Usage					
Usage	-0.0032	-0.0050	-0.0084**	-0.0111**	-0.0133**
	(0.0074)	(0.0057)	(0.0036)	(0.0045)	(0.0064)
All control variables	Yes	Yes	Yes	Yes	Yes
Observations	345	345	345	345	345

Note: This table reports a panel quantile regression result of Eq (5), representing the impacts of overall financial inclusion index, outreach, and usage dimensions on income inequality (measured by GINI disposable) in panels A, B and C, respectively. Columns 1 to 5 represent 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} quantiles of income inequality. Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

Our threshold model denotes a jumping character representing a structural break regarding the relationship between income inequality and financial inclusion. Accordingly, the threshold model accommodates different possible links in terms of signs, magnitudes, and significance in distinct regimes between income inequality and financial inclusion. The test for the presence of threshold is undertaken by using bootstrap procedure (Hansen,1999; Wang, 2015). Testing the threshold effect is identical to testing whether the coefficients are the same in each regime, in

terms of signs, magnitudes, and significance. The null hypothesis, linear model, versus alternative hypothesis, single threshold model, is given as follows:

$H_0 : \beta_1 = \beta_2 \qquad H_A : \beta_1 \neq \beta_2$

Table 4 presents the results of the threshold estimator and threshold effect test. The threshold estimator indicates that the threshold of financial inclusion index is 0.143, the lower and upper bounds being 0.140 and 0.143, respectively. The corresponding threshold effect test shows that we reject the null hypothesis of linear model in favour of single threshold at the 1% significance level[11]. This implies a presence of nonlinear financial inclusion and income inequality nexus; therefore, we expect a differential effect, in terms of sign, magnitude, and (or) significance, of financial inclusion on income inequality when financial inclusion index is below and above the threshold. We fail to reject the null of no threshold effect under the case of financial outreach. In the case of usage dimension, however, we reject the null of no threshold. Thus, we expect that the effect of usage dimension on income inequality varies when usage dimension is below and above the threshold, 0.119.

Table 4

Panel threshold estimator and threshold effect test results.

Threshold estimator					
Model: Th-1	Threshold	Lower	Upper		
Overall FII	0.143	0.140	0.143		
Outreach	0.108	0.102	0.109		
Usage	0.119	0.116	0.121		
Threshold effect test					
Threshold (single)	F-statistics	p-value	Crit10	Crit5	Crit1
Overall FII	123.32	0.0036	78.92	97.65	121.16
Outreach	74.36	0.3150	87.31	95.20	109.70
Usage	118.25	0.0047	76.37	87.95	115.60

Note: This table presents threshold estimators and threshold tests following Eq (6); the upper panel represents the threshold estimators (and their respective lower and upper bounds) of financial inclusion index, outreach, and usage dimensions; and the lower panel presents the threshold effect tests of financial inclusion index, financial outreach, and usage dimensions (on income inequality).

Table 5 presents the results of the panel threshold regression that follows the threshold estimator and threshold effect test. The results demonstrate that lower regime (below threshold) financial inclusion index does not significantly impact income distribution; however, higher regime (above threshold) financial inclusion reduces income inequality. A similar result holds for the usage dimension. Thus, financial inclusion has significant distributional effect of reducing income inequality solely after some degree of financial inclusion is achieved.

[11] The p-value, which is 0.0036, shows we reject the null of no threshold in favor of threshold effect. Fstat is also greater than all the critical values at 10%, 5% and 1%, implying that we reject the null hypothesis in favor of the alternative.

Table 5

Panel threshold regression results.

Variables	Overall FII		Usage	
	q_i<=0.143	q_i>0.143	q_i<=0.119	q_i>0.119
(1)	(2)	(3)	(4)	(5)
FI_j	-0.0036	-0.0100***	-0.0162	-0.0063**
	(0.0130)	(0.0035)	(0.0149)	(0.0025)
GDP growth	-0.0001	-0.0002**	-0.0003	-0.0001
	(0.0001)	(0.0001)	(0.0002)	(0.0001)
GDP per capita	0.0088***	0.0006	0.0092***	0.0005
	(0.0019)	(0.0005)	(0.0023)	(0.0005)
Education	0.0102	-0.0054	0.0059	-0.0061
	(0.0100)	(0.0080)	(0.0107)	(0.0076)
Inflation	0.0039*	-0.0003	0.0065**	0.0025
	(0.0021)	(0.0030)	(0.0027)	(0.0025)
Government expenditure	-0.0304***	0.0037	0.0173	-0.0029
	(0.0109)	(0.0080)	(0.0125)	(0.0075)
Natural resource	-0.0084	0.0122	-0.0086	0.0060
	(0.0069)	(0.0075)	(0.0079)	(0.0064)
Remittance	0.0734***	0.0596***	0.0622***	0.0625***
	(0.0142)	(0.0119)	(0.0240)	(0.0100)
Trade	-0.0092***	-0.0088***	-0.0133***	-0.0081***
	(0.0030)	(0.0019)	(0.0043)	(0.0020)
Urbanization	-0.0433***	-0.0059	-0.0396**	-0.0015
	(0.0160)	(0.0117)	(0.0163)	(0.0126)
Constant	0.4870***		0.4850***	
	(0.0046)		(0.0045)	
Observations	345		345	
R-squared	0.293		0.253	
Number of countries	23		23	

Note: This table reports an endogenous threshold regression results of Eq (6) for financial inclusion measurements having threshold effects (overall FII and usage dimension because outreach dimension has no threshold effect) based on the results in Table 4. Columns 1 and 2 present the results corresponding to when financial inclusion index is below and above threshold; columns 3 and 4 report the results corresponding to when usage dimension is below and above threshold. Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

The results imply that financial inclusion has favourable distributional effect after threshold financial inclusion is achieved; some degree of financial inclusion is required for structural break in the relationship between the variables to occur. At low financial inclusion stage, financial service is possibly disproportionately used by the well-connected and incumbent economic agents because elite protecting institutions favour them (Cheng & Wu, 2019). Moreover, at early stage of financial services, contract enforcement is weak, thereby triggering a better access to credit for informationally transparent economic agents than for those informationally opaque. At a later stage, institutions and contract enforcements improve, so that financial services are available to those impeded from financial services due to institutional barriers and weak contract enforcement (Oechslin, 2009). Once some degree of financial inclusion is achieved, therefore, structural break

occurs regarding the distributional effect of financial inclusion; and financial inclusion reduces income inequality.

4.4. Does the effect of financial inclusion depend on institutional quality?

Households and firms with opaque information, poor collateral, and poor credit history are usually excluded from accessing financial services in the presence of information asymmetry, financial market imperfection, and failures. Under such circumstances, firms and households with better credit history and collateral disproportionally benefit from financial services such as credit, leading to persistent (or increased) income gap in an economy. The literature shows asymmetric information is more prevalent in countries characterized by poor institutional quality than those endowed with good institutions (Marcelin & Mathur, 2014); and in countries where institutions are weak, politically connected economic agents enjoy preferential access to credit (Khwaja & Mian, 2005). The literature further shows institutions such as better legal rights, judicial process, judicial independence, and rule of law demonstrate the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders. Thus, quality institution eases lending and plays a decisive role in improving financial inclusion by reducing information asymmetry, cost of access to credit, and preferential access to credit (Rajan & Zingales, 2003; Baltagi et al., 2009; Oechslin, 2009; Huang, 2010; Yang, 2011; Fowowe, 2014; Allen et al., 2016). In weak institutions, on the contrary, firms and households that are politically connected and with better collateral and credit history disproportionally enjoy the benefit of financial services such as credit, triggering the persistence (or widening) of income inequality. Consequently, we hypothesise that the impact of financial inclusion on income inequality depends on institutional quality.

To test the hypothesis, we included protection of property right, as one of the indicators of institutional quality, that measures a degree to which property right is clearly defined and protected. It is measured on a 1 to 7 ratings when 1 represents that property rights are poorly defined and not protected by law, while 7 represents that property rights are clearly defined and well protected by law; as such, higher values imply better institutional quality. We also included legal enforcement of contract as another measurement of institutional quality; it measures the time and money required to collect a debt, where the time cost is measured in number of calendar days required from the moment the lawsuit is filed until payment, and the monetary cost of the case is measured as a percentage of the debt. It is measured on zero-to-10 ratings; the higher the rate, the more effective the contract enforcement of law and hence the better the institutional quality.

We classified institution as *High institution* if the institutional quality indicator under consideration is higher than the samples mean in terms of the indicator, and *Low institution*, which is given by one minus *High institution*, if the indicator is lower than the samples mean. Put

differently, the dummy variable *High institution* denotes those countries experiencing better institutional quality because their institutional quality, in terms of the respective indicator, is higher than the sample mean, while the *Low institution* dummy represents countries experiencing lower institutional quality. The intuition is to delineate the impact of financial inclusion on income inequality in institution of lower quality from that of higher quality. Accordingly, we re-estimated our model replacing financial inclusion by *FI* x *High institution* and *FI* x *Low institution* and including the dummy *High institution*.

Table 6 presents the results. Panel A presents the results associated with protection of property right. Under the financial inclusion index, column 2, we can see that both *FI* x *High institution* and *FI* x *Low institution* reduces income inequality; however, the former has more favorable distributional effect. The Chow test also shows that we reject the null that the coefficients of *FI* x *High institution* and *FI* x *High institution* are equal ($\mu_1=\mu_2$) at the 1% significance level. In the case of financial outreach and usage dimensions, *FI* x *High institution* reduces income inequality; *FI* x *Low institution*, however, does not significantly impact income inequality, implying that financial outreach and usage dimensions play significant favorable distributional roles only under higher institutional quality. The Chow test also supports the differential effects of financial outreach and usage dimensions under high and low protection of property right. Panel B presents results related to the legal enforcement of contract. Column 2 shows that financial inclusion index significantly reduces income inequality both under higher and lower institutional quality; the favourable distributional effect is more pronounced under higher quality institution measured by better legal enforcement of contract. Column 3 shows no evidence for differential effect of financial outreach under lower and higher institutional quality because we fail to reject the null hypothesis that the two coefficients are the same ($\mu_1=\mu_2$). Column 4 shows that usage dimension significantly reduces income inequality only under higher institutional quality proxied by better legal enforcement of contracts.

Table 6

Impact of financial inclusion on income inequality across low vs high institutional quality.

Variables	Overall FII	Outreach	Usage
(1)	(2)	(3)	(4)
Panel A: Protection of property right			
FI_j × High institution (μ_1)	-0.0138***	-0.0102***	-0.0089***
	(0.0035)	(0.0032)	(0.0026)
FI_j × Low institution (μ_2)	-0.0068*	-0.0046	-0.0029
	(0.0037)	(0.0035)	(0.0029)
All control variables	Yes	Yes	Yes
F-statistics for test: $\mu_1 = \mu_2$	8.22	6.12	6.82
p-value for the test	0.0044	0.0140	0.0095
Observations	345	345	345
R-squared	0.259	0.244	0.248
Number of countries	23	23	23
Panel B: Legal enforcement of contract			
FI_j × High institution (μ_1)	-0.0143***	-0.0122***	-0.0082***
	(0.0032)	(0.0030)	(0.0024)
FI_j × Low institution (μ_2)	-0.0092**	-0.0089***	-0.0025
	(0.0036)	(0.0031)	(0.0032)
All control variables	Yes	Yes	Yes
F-statistics for test: $\mu_1 = \mu_2$	3.06	1.25	4.70
p-value for the test	0.0814	0.2646	0.0309
Observations	345	345	345
R-squared	0.257	0.249	0.240
Number of countries	23	23	23

Note: This table presents the results on whether the effect of financial inclusion on income inequality depends on the underlying institutional quality. Panels A and B present the results when institutional quality is proxied by protection of property right and legal enforcement of contract, respectively. Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

4.5. Robustness checks

4.5.1. Instrumental variable regression

Fixed effect estimation addresses endogeneity arising from correlation between time invariant country-specific effect and time variant regressors. However, it does not tackle endogeneity that arises from other sources such as measurement error, omitted variable bias, and reverse causality. In our case, a possible endogeneity arises from reverse causality because existing income distribution can possibly cause financial inclusion. To tackle this potential endogeneity problem, we used external instrumental variables (IV) for financial inclusion as a robustness check.

We employed external instruments for financial inclusion following the literature related to finance–inequality nexus. De Haan and Sturm (2017) used legal origin as instrument for financial development. Kim and Lin (2011) used legal origin, religious composition, and initial financial development as instruments for financial development. Following these empirical studies, we used legal origin, initial financial inclusion, and religion composition as instruments for financial

inclusion. The literature shows English-originated common law countries protect creditors and shareholders better, thereby facilitating higher financial development, than French-originated civil law countries (La Porta et al., 2008). The literature also shows that countries where Catholicism and Islam are dominant religions—compared to where Protestantism is a dominant religion—favour state intervention, thereby undermining market outcome and property right protection. Consequently, countries where Protestantism is a dominant religion experience superior financial development than those where Catholicism or Islam is a dominant religion (La Porta et al., 1999)[12].

Table 7 presents the IV regression results. Column 2 shows that overall financial inclusion reduces income inequality. Columns 3 and 4 show that outreach and usage dimensions also favourably impact income distribution. Therefore, we can conclude that the favourable distributional impact of financial inclusion is robust when financial inclusion is instrumented by external instrumental variables that tackle potential endogeneity problems. Postestimation tests show the model is well identified. The under-identification test shows that we reject the null hypothesis that the model is under-identified. The weak identification test result shows we reject the null hypothesis of weak instrument because F statistic is greater than critical values. The overidentification test also shows that we fail to reject the joint null hypothesis that the instruments are valid. Thus, we can conclude that the model is well identified.

4.5.2. Alternative measurement of income inequality

In this sub section, we use GINI market, which is pre-tax and pre-transfer, as a measurement of income inequality to check the sensitivity of the results to alternative measurement of income inequality. GINI market measures income inequality unadjusted to government tax and transfer, while GINI disposable measures income inequality adjusted to tax and transfer. The difference between gross and net GINI varies between countries and also within a country over time. Their difference depends on the nature of fiscal policy in an economy at a given time and over a time: the difference between net and gross GINI index depends on the degree of progressiveness and redistributive taxes and transfer in redistributing income from rich to poor population (Bergh & Nilsson, 2010). Thus, depending on the degree of the redistributive effect of taxes and transfers, the difference between net and gross income GINI coefficient varies across countries, and over time within a country. Due to this difference between the two measurements of income inequality, our financial inclusion and income inequality nexus can potentially be sensitive to the choice

[12] It is plausible to argue that legal origin and religious composition do not affect income inequality directly but indirectly through their effect on financial inclusion.

between the two. Therefore, in this sub-section, we investigate the sensitivity of our result to using gross GINI index as a measurement of income inequality.

Table 7

IV Estimation Results.

Variables	Overall FII	Outreach	Usage
(1)	(2)	(3)	(4)
FI_j	-0.0140***	-0.0099***	-0.0093***
	(0.0035)	(0.0031)	(0.0028)
GDP growth	-0.0001**	-0.0001**	-0.0001**
	(0.0001)	(0.0001)	(0.0001)
GDP per capita	0.0004	0.0001	0.0005
	(0.0005)	(0.0005)	(0.0005)
Education	0.0065	0.0088	-0.0033
	(0.0086)	(0.0093)	(0.0081)
Inflation	0.0034**	0.0037**	0.0033*
	(0.0017)	(0.0017)	(0.0017)
Government expenditure	0.0083	0.0059	0.0082
	(0.0072)	(0.0072)	(0.0072)
Natural resource	-0.0047	-0.0030	-0.0041
	(0.0056)	(0.0056)	(0.0056)
Remittance	0.0587***	0.0571***	0.0602***
	(0.0109)	(0.0110)	(0.0109)
Trade	-0.0062***	-0.0054***	-0.0066***
	(0.0019)	(0.0019)	(0.0019)
Urbanization	0.0002	-0.0172	0.0022
	(0.0126)	(0.0113)	(0.0135)
Constant	0.4780***	0.4820***	0.4810***
	(0.0177)	(0.0174)	(0.0175)
Observations	322	322	322
Number of countries	23	23	23
Under-identification test			
LM statistic	265.171	264.204	249.929
p-value	0.0000	0.0000	0.0000
Weak identification test			
Cragg-Donald Wald F statistic	237.973	280.681	176.859
Stock-Yogo test critical value	19.28	19.28	19.28
Over-identification test			
Sargan statistic	5.808	5.591	5.740
p-value	0.3253	0.2319	0.3323

Note: This table presents IV regression results when financial inclusion is instrumented by historical institutional factors such as legal origin and religion composition. Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

Table 8 presents the effect of financial inclusion on income inequality measured by GINI market. Colum 2 shows that overall financial inclusion reduces income inequality. Columns 3 and 4 illustrate that financial outreach and usage dimensions favourably impact income distribution.

The results, thus, demonstrate that the favourable distributive effect of financial inclusion is robust to using alternative measurement of income inequality.

Table 8

GINI market as an alternative measurement of income inequality.

Variables	Overall FII	Outreach	Usage
(1)	(2)	(3)	(34
FI_j	-0.0163***	-0.0083**	-0.0123***
	(0.0040)	(0.0038)	(0.0029)
GDP growth annual	-0.0001*	-0.0001	-0.0001*
	(0.0001)	(0.0001)	(0.0001)
GDP per capita	-0.0002	-0.0005	0.0001
	(0.0005)	(0.0006)	(0.0006)
Education	0.0045	0.0070	0.0084
	(0.0156)	(0.0160)	(0.0155)
Inflation	0.0044**	0.0048**	0.0042**
	(0.0021)	(0.0022)	(0.0021)
Government expenditure	-0.00002	-0.0027	0.0017
	(0.0083)	(0.0084)	(0.0083)
Natural resource	0.0024	0.0054	0.0036
	(0.0067)	(0.0068)	(0.0067)
Remittance	0.0777***	0.0759***	0.0756***
	(0.0122)	(0.0125)	(0.0122)
Trade	-0.0103***	-0.0095***	-0.0105***
	(0.0022)	(0.0022)	(0.0022)
Urbanization	0.00438	-0.0151	0.0204
	(0.0161)	(0.0163)	(0.0171)
Constant	0.5090***	0.5130***	0.5010***
	(0.0102)	(0.0108)	(0.0102)
Observations	345	345	345
R-squared	0.213	0.182	0.216
Number of countries	23	23	23
Year fixed effects	Yes	Yes	Yes

Note: This table reports a robustness check when GINI market is used as an alternative measurement of income inequality (dependent variable). Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

4.5.3. Bayesian model averaging as robustness check for model uncertainty

In this section, we undertake sensitivity analysis of the finding to model uncertainty that arises from possibility of different combinations of the explanatory variables claiming to be a true model that explains the dependent variable. Bayesian model averaging (BMA) addresses a problem related to two levels of model uncertainty: uncertainty associated to specification of empirical model, and uncertainty associated to parameters conditional on a given model (Moral-Benito, 2012; Moral-Benito, 2016). Following Moral-Benito (2012), we employed panel BMA to address

the potential model uncertainty[13]. Assume that we have K different explanatory variables that are possible determinants of a dependent variable. Then we have 2^K different models, indexed by M_j, where j=1, …, 2^K, with 2^K possible combinations of regressors all seeking to explain the data[14]. This causes uncertainty about which is the true model. For a group of explanatory variables, that is, for a given model M_j, the estimated econometric equation consists of the following form in our panel data setting:

$$GINI_{it} = X_{it}^{'j}\gamma^{j} + \alpha_i + \varepsilon_{it}, \quad i=1, 2, \ldots, N; t=1, 2, \ldots, T \tag{7}$$

We observe $GINI_{it}$ (income inequality) and the vector $k^j x1$ of explanatory variables X_{it}^{j} but not α_i that is, the time invariant unobserved country characteristics[15].

Table 9 presents the result of panel BMA. Panel A represents the results related to the financial inclusion index. Columns 2–5 denote posterior probability of inclusion (PIP), posterior mean of the coefficients (PM), posterior standard deviation (PSD), and (the probability of) conditional positive sign (CPS) of the coefficient, respectively. The PIP of financial inclusion index is 0.9700, implying that it is a robust determinant of income inequality. The negative PM of the coefficient of financial inclusion index, -0.0104, implies that financial inclusion reduces income inequality. The posterior probability of CPS of the coefficient of financial inclusion, conditional on financial inclusion is included in the model, is 0.0000 implying the possibility that financial inclusion raises income inequality is zero. Therefore, we can conclude that financial inclusion has a robust, favourable distributional effect. Panels B and C present the effects of financial outreach and usage dimensions on income inequality[16]. The results are qualitatively similar to that of the overall financial inclusion impact. Therefore, we conclude that the favourable distributional effect of financial inclusion is robust to model uncertainty sensitivity analysis—the result is robust to uncertainty related to parameter conditional on a given model and uncertainty related to empirical model specification.

[13] See BMA literature based cross sectional data set, in the case of growth context (Fernandez et al.,2001; Sala-i-Martin et al., 2004).

[14] See Moral-Benito (2012) for the details about the prior and posterior of the parameters, and prior model probability and the derivation of its posterior probability and more.

[15] In our case, we have 2^{11} potential true models with 2^{11} numbers of possible combinations of regressors seeking to explain our dependent variable, i.e., income inequality. This creates model uncertainty—both model specification uncertainty and parameter uncertainty conditional on a given empirical model.

[16] The control variables are not reported due to space limit. They are available on request.

Table 9

Panel Bayesian model averaging.

Variables	PIP	PM	PSD	CPS
(1)	(2)	(3)	(4)	(5)
Panel A: Overall FII				
Overall FII	0.9700	-0.0104	0.0042	0.0000
GDP growth	0.8097	-0.0003	0.0001	0.0000
GDP per capita	0.2570	0.0001	0.0004	0.9533
Education	0.2003	0.0007	0.0050	0.8153
Inflation	0.8203	0.0009	0.0003	1.0000
Government expenditure	0.1343	-0.0004	0.0038	0.3474
Natural resource	0.1547	0.0001	0.0033	0.6229
Remittance	1.0000	0.0525	0.0155	1.0000
Trade	0.9907	-0.0085	0.0026	0.0000
Urbanization	0.5587	0.0030	0.0135	0.7303
Observations	345	345	345	345
Panel B: Outreach				
Outreach	0.8387	-0.0064	0.0034	0.0000
All control variables	Yes	Yes	Yes	Yes
Observations	345	345	345	345
Panel B: Usage				
Usage	0.9667	-0.0081	0.0020	0.0000
All control variables	Yes	Yes	Yes	Yes
Observations	345	345	345	345

Note: This table presents sensitivity analysis using panel BMA (Bayesian model averaging) to check the robustness of the results to model uncertainty. Columns 1–4 present posterior inclusion probability (PIP), posterior mean (PM), posterior standard deviation (PSD), and the probability of conditional positive sign (CPS) of the coefficient, respectively. Panels A, B, and C present the results associated with financial inclusion index, financial outreach dimension, and usage dimension. Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

4.5.4. Sub-sampling into low and high financial inclusion as robustness for the threshold result

In this sub-section, we split the countries into those with high financial inclusion and low financial inclusion as a robustness check for the threshold model. In effect, we exogenously used sample mean of financial inclusion index and dimensions as their respective thresholds to substantiate whether structural break is observed regarding the relationship between financial inclusion and income inequality depending on the degree of financial inclusion of an economy.

Table 10 presents the results. Columns 2, 3, and 4, and columns 5, 6, and 7 represent results related to low- and high-financial inclusion, respectively. Comparing the result of overall financial inclusion index under the case of low- and high-financial inclusion index given in columns 2 and 5, respectively, we can see that financial inclusion has significant favourable distributional effect only under the case of high-financial inclusion. Outreach dimension, both under low- and high-

outreach as presented in columns 3 and 6, does not significantly reduce income inequality, implying no evidence for the presence of nonlinear nexus. Similar to the case of overall financial inclusion index, the usage dimension significantly reduces income inequality only under higher usage, not under lower usage, as given in columns 4 and 7, implying nonlinear nexus between usage dimension and income inequality. Therefore, we conclude that the endogenous threshold regression results discussed in Section 4.3, that financial inclusion index and usage dimensions nonlinearly impact income inequality, are robust to exogenously determining the sample mean of the respective financial inclusion as thresholds.

5. Conclusion

The importance of inclusive economic growth is increasingly receiving global policy priority. Sustainable Development Goals, for example, focuses on the importance of inclusive economic growth to achieve sustainable development; specifically, SDG10 aims to reduce inequality within and among countries. Achieving an inclusive financial system so that everyone enjoys the benefits of financial services is also increasingly among the top global policy priorities. Despite common understandings about the importance of realizing inclusive economic growth and financial system, little is known regarding the financial inclusion and income inequality nexus. Theoretical literature related to the finance–inequality nexus is controversial; and related empirical findings are also mixed.

Therefore, in this study, we examined the effect of multidimensional financial inclusion on income inequality using panel data for 23 African countries over the period 2004–2018. First, we developed an index of financial inclusion employing two-stage PCA. In the first stage PCA, we developed financial outreach and usage dimensions from their respective indicators. In the second stage, we developed the financial inclusion index from financial outreach and usage dimensions developed in the first stage indexing.

Table 10

Splitting the sample into low and high financial inclusion.

Variables	Overall FII	Outreach	Usage	Overall FII	Outreach	Usage
(1)	(2)	(3)	(4)	(5)	(6)	(7)
FI_j	-0.0060	-0.0041	0.0008	-0.0150***	-0.0019	-0.0098***
	(0.0079)	(0.0114)	(0.0092)	(0.0048)	(0.0043)	(0.0030)
GDP growth	-0.0001	-0.0001	-0.0001	0.0001	0.00003	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
GDP per capita	0.0020	0.0051	-0.0006	-0.0013***	-0.0001	0.00005
	(0.0036)	(0.0032)	(0.0038)	(0.0005)	(0.0006)	(0.0005)
Education	0.0201	0.0205	0.0242	-0.0200	0.0173	0.0048
	(0.0176)	(0.0183)	(0.0182)	(0.0189)	(0.0182)	(0.0214)
Inflation	0.0031	0.0042*	0.0033	0.0033	0.0022	0.0051
	(0.0022)	(0.0022)	(0.0022)	(0.0030)	(0.0027)	(0.0035)
Government expenditure	0.0014	-0.0022	0.0070	0.0088	0.0124*	0.0075
	(0.0123)	(0.0125)	(0.0127)	(0.0072)	(0.0064)	(0.0073)
Natural resource	-0.0176*	-0.0126	-0.0158	-0.0065	0.0027	-0.0060
	(0.0097)	(0.0103)	(0.0100)	(0.0065)	(0.0061)	(0.0076)
Remittance	0.0364**	0.0534***	0.0254	0.0258	-0.0034	0.0750***
	(0.0152)	(0.0143)	(0.0189)	(0.0194)	(0.0190)	(0.0197)
Trade	-0.0034	-0.0066**	-0.0039	-0.0063***	-0.0047***	-0.0072***
	(0.0034)	(0.0033)	(0.0034)	(0.0018)	(0.0018)	(0.0021)
Urbanization	0.124***	0.0514*	0.146***	-0.0684***	-0.0521***	-0.0259
	(0.0292)	(0.0306)	(0.0285)	(0.0144)	(0.0136)	(0.0165)
Constant	0.4220***	0.4380***	0.4180***	0.5430***	0.5150***	0.5090***
	(0.0115)	(0.0123)	(0.0120)	(0.0135)	(0.0141)	(0.0154)
Observations	206	222	207	139	123	138
R-squared	0.239	0.207	0.249	0.641	0.498	0.540
Number of countries	17	21	17	13	13	13
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports a robustness check for the endogenous threshold model by exogenously determining sample mean of financial inclusion measurements as their respective thresholds. Standard errors are in parentheses. ***, ** and * represents significance at the 1%, 5% and 10% level, respectively.

Our baseline result, obtained using fixed effect analysis, shows that the overall financial inclusion reduces income inequality. We investigated whether the dimensions have differential distributional effects and found that financial outreach and usage dimensions have impacts on income inequality that are qualitatively similar to that of financial inclusion index. Given the baseline fixed effect result is based on the mean value analysis, it hides information related to whether the effect of financial inclusion varies across quintiles of income inequality. Therefore, employing a novel panel quantile regression to scrutinize whether the distributional effect of financial inclusion depends on quantiles of inequality under consideration, we found that financial inclusion has more favourable distributional effect at higher quantiles of inequality. A similar result holds for the usage dimension. The results show that an inclusive financial system has a more favourable distributional effect in more unequally distributed economies. However, no evidence of differential effect across quantiles of income inequality is observed for the financial outreach dimension.

The baseline findings also assume that the effect of financial inclusion on income inequality is linear and hence it does not address for a possibility of nonlinear nexus between the two variables. However, there exists a likelihood of nonlinear nexus arising from potential structural break regarding the effect of financial inclusion on income inequality. Consequently, employing an endogenous panel threshold model, we demonstrated the presence of nonlinear financial inclusion and income inequality nexus: financial inclusion favourably impacts income distribution only under higher regime financial inclusion. Put differently, only financial inclusion above threshold reduces income inequality; and financial inclusion below threshold does not have a significant distributional effect.

We further examined whether the distributional effect of financial inclusion depends on the underlying institutional quality. The literature shows that households and firms with opaque information, poor collateral, and poor credit history are excluded from accessing financial services such as credit in the presence of information asymmetry and financial market imperfection and failures. Although information asymmetry, financial market imperfection, and failure are common in the financial market, they are prevalent in countries where institutional quality is weak. In countries where institutions are weak, the literature shows, firms and people who are politically connected enjoy preferential access to financial services such as credit. Thus, if institutions are weak, those with better collateral and credit history and that are politically connected disproportionally enjoy the benefit of financial services, triggering the persistence (or increment) of income inequality. Thus, we examined whether the effect of financial inclusion on income

inequality depends on institutional quality and demonstrated that financial inclusion has more favourable distributional impacts in higher quality institutions.

Our results are robust to several sensitivity analyses. Instrumenting financial inclusion by legal origin, initial financial inclusion, and religion composition, we employed IV estimation to address possible endogeneity arising from reverse causality. Using pre-tax and pre-transfer GINI index, we scrutinized whether our results are sensitive to alternative measurement of income inequality. Employing panel BMA estimation that tackles model uncertainty (related to parameter uncertainty conditional on a given model and uncertainty to empirical model specification), we investigated sensitivity analysis of the result to model uncertainty. Exogenously determining the sample mean of financial inclusion as threshold, and hence splitting our sample into high and low financial inclusion, we investigated the robustness of the endogenous threshold regression results. All the sensitivity analyses demonstrate that our results regarding the effect of financial inclusion on income inequality are robust.

Our results highlight a number of interesting policy implications. The result that financial inclusion has disproportionate favourable distributional impact in economies of more unequally distributed income suggests that countries experiencing higher income inequality benefit more by enhancing an inclusive financial system as an instrument of inclusive economic growth. The point that only a higher degree of financial inclusion reduces income inequality implies that fostering policies that promote inclusive financial system is essential for attaining the threshold financial inclusion required to reap its distributional benefits. The dependence of financial inclusion impacts on quality institutions highlight that financial inclusion and institutional quality play a complementary distributional role: promoting quality institutions is essential for enjoying pronounced distributional effect of financial inclusion as an instrument of reducing income inequality, thereby achieving one of the Sustainable Development Goals.

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Appendix A

Table A1
Variables and data sources

Variable	Definition	Source
Income inequality		
GINI disposable	Gini index of inequality after tax and transfer	SWIID, 2020
GINI gross	Gini index of inequality: pre-tax, pre-transfer (as a robustness check)	SWIID, 2020
Financial inclusion		
Outreach	The outreach dimension of financial inclusion indexed using principal components analysis (PCA) from four indicators of geographic and demographic penetration of bank branches and ATMs.	FAS, 2020
Usage	The usage dimension of financial inclusion indexed using PCA from four indicators of deposit and credit services of banking industry.	FAS, 2020
Overall FII	The overall financial inclusion index constructed, employing two stage PCA, from outreach and usage dimensions of financial inclusion.	FAS, 2020
Institutional quality indicators		
Legal enforcement of contracts	Measures the time and money required to collect a debt on zero-to-10 ratings where the time cost is measured in number of calendar days required from the moment the lawsuit is filed until payment, and the monetary cost of the case is measured as a percentage of the debt. The higher the rate, the more effective the contract enforcement of law.	Fraser Institute, 2020
Protection of property rights	Measures a degree to which property right is clearly defined and protected on a 1 to 7 ratings; 1 means that property rights are poorly defined and not protected by law while means that property rights are clearly defined and well protected by law.	Fraser Institute, 2020
Control variables		
Education	Education index is developed from the arithmetic mean of two indicators of schooling. These are: 1, Mean years of schooling: average number of years of education received by people ages 25 and older; and 2, Expected years of schooling: number of years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrolment rates persist throughout the child's life.	UNDP, 2020
GDP growth	GDP growth, annual.	
GDP per capita	GDP per capita (constant 2010 US$) in '000s.	WDI, 2020
Government expenditure	General government final consumption expenditure (% of GDP) expenditure.	WDI, 2020
Inflation	Inflation, GDP deflator (annual %), in 100s.	WDI, 2020

Natural resource	Total natural resources rents to GDP.	WDI, 2020
Remittance	Personal remittances received to GDP.	WDI, 2020
Trade openness	Trade to GDP.	WDI, 2020
Urbanization	Urban population to total population.	WDI, 2020
Instrumental variables		
Catholic	A dummy variable that takes a value 1 if Catholics are the dominant religious group in the country and 0 otherwise	La Porta et al. (1999)
Muslim	A dummy variable that takes a value 1 if Muslims are the dominant religious group in the country and 0 otherwise	La Porta et al. (1999)
French legal origin	A dummy variable that takes a value 1 if a country is of the French legal origin family and 0 otherwise	La Porta et al. (2008)

Note: This table presents the variables used in the analysis, their definitions, and data sources. FAS: Financial Access Survey; WDI: World Development Indicators; SWIID: Standardized World Income Inequality Database; UNDP: United Nations Development Program.