



Financial inclusion and poverty alleviation: an empirical examination

Sumanta Kumar Saha¹ · Jie Qin²

Received: 28 January 2022 / Accepted: 28 June 2022 / Published online: 20 July 2022
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract

This study analyzes the impact of financial inclusion on poverty reduction in 156 countries belonging to different income groups during the 2004–2019 period. We construct a novel composite financial inclusion index and apply both static and dynamic panel estimation methods to examine the impact of financial inclusion on two different poverty levels. Our results indicate that financial inclusion has a significant negative association with extreme poverty in developing countries but not in high-income countries. The effect of financial inclusion on moderate poverty is weaker than that on extreme poverty. We also examine the conditional relationship between gender inequality and financial inclusion, finding that improvement in gender inequality enhances the effect of financial inclusion on both extreme and moderate poverty in developing countries. The effectiveness of financial inclusion is influenced by how equally the disadvantaged groups, particularly women, can access and utilize financial services. Our findings suggest that policymakers can use financial inclusion as a poverty reduction tool.

Keywords Financial inclusion · Poverty alleviation · Gender inequality · Access to finance

JEL Classification G21 · I32 · I38 · O11 · O16 · J16

✉ Sumanta Kumar Saha
sumantabb08@yahoo.com

Jie Qin
khata@ec.ritsumeikai.ac.jp

¹ Financial Stability Department, Bangladesh Bank (The Central Bank of Bangladesh), Flat B2, 52/1, South Basabo, Dhaka 1214, Bangladesh

² College of Economics, Ritsumeikan University, Nojihigashi 1-1-1, Kusatsu, Shiga 525-0058, Japan

1 Introduction

Poverty alleviation is a key objective for many countries.¹ The World Bank has estimated that roughly 150 million new people will live in extreme poverty due to the recent Covid-19 pandemic (Poverty and Shared Prosperity 2020: Reversals of Fortune). Due to the recent surge in poverty, identifying policy instruments to alleviate poverty is crucial. One such policy tool is financial inclusion.

Randomized studies by Demircuc-Kunt et al. (2017), Aker et al. (2014), and Babatz (2013) suggest that financial inclusion reduces poverty through access to payment, savings, credit, and insurance services. Cross-country studies by Park and Mercado (2018), Swamy (2010), and Omar and Inaba (2020) demonstrate a negative association between financial inclusion and poverty. Recent studies, including those by Kara et al. (2021) and Aslan et al. (2017), suggest that the efficacy of financial inclusion as a policy tool may be affected by the inequality of access to financial services. In particular, disadvantaged groups such as females, ethnic minorities, disabled people, and immigrants have a lower probability of accessing financial services. The next section provides a more detailed literature review.

This study constructs a novel financial inclusion index to examine the effect of financial inclusion on poverty. Our results demonstrate that financial inclusion has a significant negative association with poverty in developing countries but not in high-income countries.² Among developing countries, financial inclusion has a stronger association with poverty in upper-middle-income countries than in lower-middle-income countries and low-income countries. Our results also suggest that the effect of financial inclusion on moderate poverty is weaker than that on extreme poverty. We also examine the influence of gender inequality, finding that if gender inequality is reduced, financial inclusion has a stronger negative association with extreme and moderate poverty in developing countries.

Our method follows previous studies with four notable improvements. First, the financial inclusion index constructed in this paper is more comprehensive than the index used in previous studies. The research sample includes data from commercial banks, credit cooperatives, credit unions, and microfinance institutions to assess financial inclusion levels. Second, we divide countries into different groups according to average income level, enabling a comparison of the effects of financial inclusion between countries in different stages of development. Third, we examine two levels of poverty: extreme poverty and moderate poverty. Finally, the influence of gender inequality is examined.

Our findings contribute to the existing literature in several ways. Although we find a negative association between poverty and financial inclusion, as in other

¹ As decided by the United Nations, ending poverty by 2030 is the number one Sustainable Development Goals (SDG-1) of member countries (UNDP Website 2021).

² We use the World Bank's income categories to classify countries into four groups: high-income, upper-middle-income, lower-middle-income, and low-income countries. Upper-middle-income, lower-middle-income, and low-income countries are labeled as developing countries. The list of countries organized by income groups is presented in Appendix A.

studies (Park and Mercado 2018; Omar and Inaba 2020), we show that the financial inclusion coefficient varies for different national income groups. We argue that unequal access to financial services might explain this behavior. To support our argument, we analyze one specific type of inequality in accessing financial inclusion services; gender inequality. Our analysis expands on previous findings (Kara et al. 2021; Aslan et al. 2017) by linking inequality in financial access with poverty reduction and empirically demonstrates that if gender equality is improved, the negative association between financial inclusion and poverty amplifies. Our findings emphasize the importance of reducing unequal access to financial services. Moreover, as we show that financial inclusion has a significant association with extreme poverty reduction in most income groups, this supports policymakers' use of financial inclusion measures as a tool for poverty alleviation.

The remainder of this article is organized into five sections. Section 2 reviews existing literature concerning financial inclusion and poverty; Sect. 3 presents the construction of financial inclusion index; Sect. 4 graphically illustrates the poverty-financial inclusion linkage in various income-groups; Sect. 5 presents the methodology, and empirical results; and Sect. 6 concludes with a summary discussion and proposed recommendations.

2 Poverty-financial inclusion linkage: review of literature

Financial inclusion can be defined as the process of making formal financial services accessible and functional for the involuntarily excluded portion of the population. According to the World Bank, financial inclusion accommodates payment, savings, credit, and insurance services for individuals and businesses.³ Kim et al. (2018) use indicators such as the numbers of ATMs, bank branches, depositors, and borrowers, and the ratio of insurance premium to GDP to measure financial inclusion. Cabeza et al. (2019) use the access to bank accounts and credit cards, as financial access indicators, to measure financial inclusion. Swamy (2010) uses priority sector lending as the proxy for financial inclusion.

The problem with such indicators is that no single indicator can capture the multi-dimensional aspects of financial inclusion. To address this challenge, Amidžić et al. (2014), Cámara and Tuesta (2014), Sarma (2012), and Honohan (2008) construct composite indices of financial inclusion. Amidžić et al. (2014) combine dimensions of outreach (geographic and demographic penetration) and usage (depositors and borrowers). In composite index construction, Le et al. (2019) use principal component analysis for their composite index. Cámara and Tuesta (2014) and Sarma (2012) combine dimension-specific indicators of accessibility, availability, and usage to construct a composite index with three sub-indices.

In their review of randomized control-based studies, Demirguc-Kunt et al. (2017) demonstrate that financial inclusion affects poverty by making payment services, savings, credit, and insurance services available to the poor. These services reduce

³ This view references the financial inclusion overview section of the World Bank website (2021).

poverty by increasing the poor's income level or allowing the poor to increase household spending by offering time and cost savings. Aker et al. (2014) and Muralidharan et al. (2014) show that digital payment of welfare benefits save cost in the form of avoidance of making a physical trip for cash collection or offering bribes to corrupt officials. These cost savings allow the poor to spend the money for other purposes, which helps reduce poverty. Similarly, Prina (2015) shows that account payments enhance women's decision-making in the household, thereby increasing the expenditure on education and food. Brune et al. (2016) and Dupas and Robinson (2013) demonstrate that savings in a formal financial institution increase private expenditure, business investment, agricultural output, and household expenditures. Although Morduch (1999) establishes the substantial benefits of micro-credit access, Banerjee et al. (2015) and Duvendack et al. (2011) find moderate benefits. All these studies have validated how financial inclusion can alleviate poverty; however, the findings of these randomized experimental studies might not be applicable for cross-country analyses due to the considerable variations among countries.

Various researchers analyze the impact of financial inclusion on poverty using cross-country analyses. Gutiérrez-Romero and Ahamed (2021) apply the theoretical framework of Ravallion and Datt (1992) for analyzing the poverty-financial inclusion relationship in 79 low and lower-middle-income countries, finding that financial inclusion primarily reduces poverty through reduction of inequality. Park and Mercado (2018, 2015) analyze the impact of financial inclusion on poverty and income inequality both globally and for developing Asian countries, determining that financial inclusion significantly reduces poverty for the entire sample and Asian developing countries. More recently, Omar and Inaba (2020) investigate the impact of financial inclusion on poverty and income inequality in 116 developing countries, demonstrating that financial inclusion significantly reduces poverty rates in developing countries. Cabeza et al. (2019) demonstrate that greater financial inclusion of women encourages economic participation of women and positively affects economic development.

Country-specific studies also find that financial inclusion helps reduce poverty. Swamy (2010) examines priority sector lending in India, finding that financial inclusion through prioritized lending can achieve inclusive growth by reducing the rural poverty rates. Abor et al. (2018) analyze the impact of financial inclusion and mobile telephone penetration on poverty in Ghana using 16,772 Ghanaian households. The study results show that mobile penetration and financial inclusion help smooth consumption and significantly reduce the probability of a household becoming poor and are correlated with an increase in per capita household consumption of food and non-food items. Though these cross-country and country-specific studies analyze the poverty-financial inclusion relationship from different perspectives, they lack a comprehensive panel data analysis on countries in different stages of development. Moreover, most studies use a limited set of variables when constructing financial inclusion indices.

Though previous studies indicate that financial inclusion negatively correlates with poverty, its impact on poverty could be weaker if access to finance fails to reach the targeted group. Kara et al. (2021) review the growing evidence regarding whether individuals' demographic characteristics (i.e., gender and race)

Table 1 Indicators used for the construction of financial inclusion index

SL	Name of the indicators	Observations
1	Number of financial institution branches per 100,000 adults	3040
2	Number of ATMs per 100,000 adults	2667
3	Number of depositors with financial institution per 1000 adults	3036
4	Number of deposit accounts with financial institution per 1000 adults	1760
5	Number of borrowers with financial institutions per 1000 adults	1460
6	Number of loan accounts from financial institutions per 1000 adults	1490

FAS financial access survey, The IMF. Calculation: Authors' assessment

and socioeconomic features (i.e., income and education) affect access to credit. They determine that less education, less financial literacy, lower income, and less wealth correlates with decreased access to credit. Moreover, women, ethnic minorities, disabled people, and immigrants are more likely to be excluded from the formal credit markets. Similarly, in a recent International Monetary Fund (IMF) study, Aslan et al. (2017) find inequality among households, particularly female-led households, in accessing the benefit of financial inclusion. These findings necessitate the investigation of how unequal access to financial services affects the impact of financial inclusion on poverty.

Researchers analyze poverty-financial inclusion linkage from different perspectives; however, some questions remain unanswered. Existing studies have not adequately analyzed how financial inclusion might affect poverty based on the income levels of different nations. Moreover, how inequality in access to financial services affects the effectiveness of financial inclusion on poverty alleviation has not been evaluated. This study investigates these issues by constructing a novel composite financial inclusion index to analyze how financial inclusion affects poverty in different income groups of countries. Furthermore, the study examines the effect of gender inequality on poverty reduction through financial inclusion.

3 Construction of composite financial inclusion index

To measure country-wise financial inclusion, we construct an equal-weighted composite financial inclusion index. Rather than relying on one specific indicator, we construct the index using data from commercial banks, credit cooperatives, credit unions, and microfinance institutions. We collect our data primarily from the Financial Access Survey of the IMF. Six different indicators are used for the index construction. The details of the indicators and their standardized scores are presented in Table 1. The composite index has a score of zero and one, where a higher score indicates a higher level of financial inclusion.

Following Sarma (2012), we construct the index of financial inclusion, estimating the standardized score for each indicator by applying Eq. (1).

$$d_{it} = \frac{x_{ijt} - m_i}{M_i - m_i}, \quad (1)$$

where d_{it} measures the standardized value for the indicator/dimension of a country at time t , x_{ijt} represents the actual value of indicator i for country j at time t , m_i is the minimum value and M_i is the upper limit of indicator i . We assign zero as the minimum value. To avoid the influence of extreme values in standardizing, we use the 90th-percentile value of each indicator as to the upper limit. If any country score exceeds one due to this upper limit, we set that score to one. This standardization ensures an indicator-specific standardized score (d_{it}) that lies between zero and one.

After standardizing the indicators, we aggregate indicators based on normalized Euclidean distance as follows:

$$FII = \frac{1}{2}(X_1 + X_2), \quad (2)$$

$$X_1 = \frac{\sqrt{d_1^2 + d_2^2 + \dots + d_6^2}}{\sqrt{w_1^2 + w_2^2 + \dots + w_6^2}}, \quad (3)$$

$$X_2 = 1 - \frac{\sqrt{(w_1 - d_1)^2 + (w_2 - d_2)^2 + \dots + (w_6 - d_6)^2}}{\sqrt{w_1^2 + w_2^2 + \dots + w_6^2}}. \quad (4)$$

In Eqs. (2)–(4), FII represents the financial inclusion index score for each country. The composite index of each country has a value between zero and one, where higher values indicate a greater level of financial inclusion. X_1 is the Euclidian distance from the worst point, X_2 is the inverse distance from an ideal point, d_i represents dimension or indicator specific scores of the countries obtained from Eq. (1), and w_i represents the weight assigned to each dimension. As we use total six dimensions and assign equal weight to each dimension, the weight of each dimension is set as $1/6$, i.e., $w_1 = w_2 = w_3 = w_4 = w_5 = w_6 = \frac{1}{6}$.

Our method follows Sarma (2012); however, there are notable differences. We use six dimensions instead of the three proposed by Sarma (2012). Moreover, we treat each indicator as a separate dimension, as opposed to using a weighted average of multiple indicators. We also use equal weights for each dimension and ensure that if any dimension has a missing value in any particular period, the corresponding weights in Eqs. (3) and (4) also remain zero. This approach is better suited for unbalanced panel data with missing values. We discuss the rationale for using equal weights in more detail in Appendix C, where we also compare our proposed index with an index constructed using Sarma's (2012) methodology.

The composite index has maximum, minimum, and average values of 1, 0.094, and 0.851, respectively, for all countries during 2004–2018. The country-wise index is presented in Appendix B. Averages of log poverty headcount ratio and

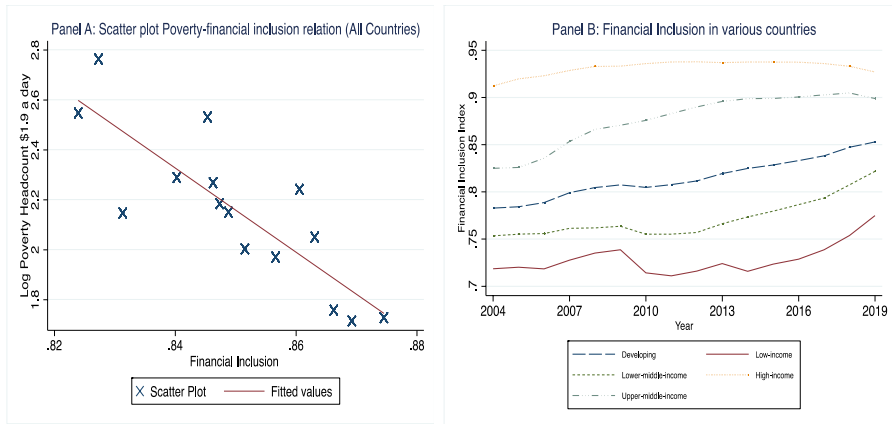


Fig. 1 Poverty–financial inclusion relationship and financial inclusion index in different countries. Source: Financial Access Survey (FAS), the IMF. Calculation: Authors' assessment

financial inclusion score of the countries for each year are plotted in panel A of Fig. 1. We use a log poverty headcount ratio of USD 1.9 per day to measure poverty. The fitted line has a negative slope in the scatter plot diagram, suggesting that higher financial inclusion might be negatively associated with poverty.

Panel B of Fig. 1 shows gradual progress in financial inclusion for different income groups of countries during the 2004–2019 period.⁴ We also use the average value of the financial inclusion index of each country group to construct the figure. A rising trend of financial inclusion, measured by the composite financial inclusion index, is found for all country income groups. The graph also depicts that although each country group has maintained an uptrend, lower-income countries also have a lower level of progress in financial inclusion. This suggests that the impact of financial inclusion might differ for different income groups. To address this issue, we separately analyze the impact of financial inclusion for each group of countries.

4 Financial inclusion and poverty in different groups of countries

In this segment, we graphically present some stylized facts regarding the linkage of extreme poverty and financial inclusion. We measure extreme poverty using the log poverty headcount ratio at USD 1.9 per day, which is defined as the percentage of the population living on less than USD 1.9 per day adjusted for 2011 international prices. Figure 2 plots log poverty headcount and financial inclusion

⁴ We do not plot a separate graph for lower-middle-income countries. Instead, we form a country group that combines lower-middle-income and low-income countries. This grouping is done to increase data availability for our regression analysis, as low-income countries do not have sufficient data. To remain consistent with our country grouping for regression analysis, we also present the combined graph of lower-middle-income and low-income countries in panel B of Fig. 1.

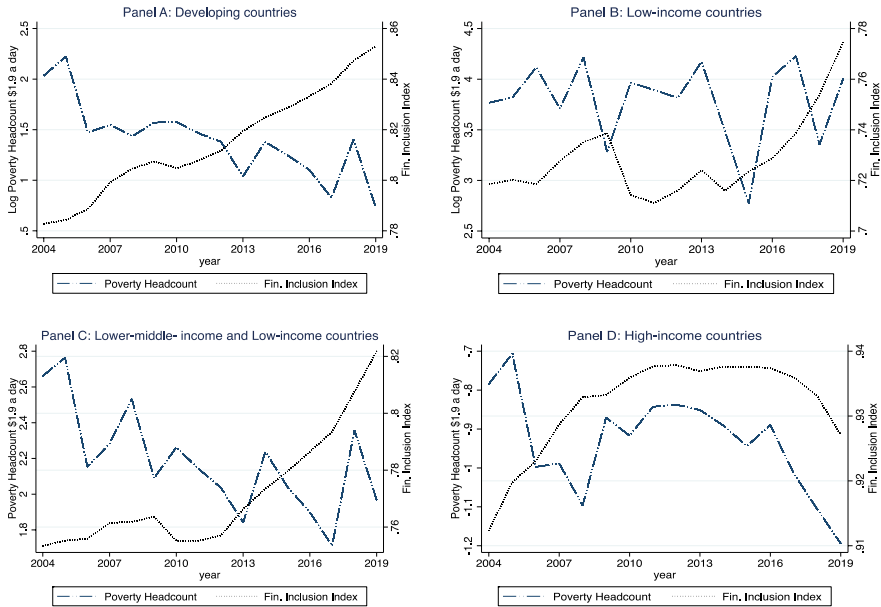


Fig. 2 Poverty and financial inclusion across countries in various income groups. Source: Financial Access Survey (FAS), the IMF. Calculation: Authors' assessment

scores for different country income groups. Following the World Bank's income categories, we classify countries into four groups: high-income, upper-middle-income, lower-middle-income, and low-income countries. Developing countries include upper-middle-income, lower-middle-income, and low-income countries.

In panel A of Fig. 2, developing countries show a steady increase in financial inclusion and a continuous drop in the poverty rate. Panel B of Fig. 2 focuses on low-income countries, and the graph indicates a lower level of financial inclusion and higher extreme poverty rates in low-income countries compared to other countries. Unequal access to financial services is a possible reason for this result. Previous studies have suggested that less wealthy people, women, and other disadvantaged groups have less opportunity to access financial products, and such disadvantaged groups are assumed to be relatively substantial in low-income countries. Enabling financial inclusion for these disadvantaged groups should advance extreme poverty reduction. In panel C, lower-middle-income and low-income countries present a trend similar to developing countries. The similarity is expected as these countries are also a substantial portion of developing countries. Panel D shows that the poverty rate is meager in high-income countries, and the relation between poverty and financial inclusion is not apparent.

Figure 2 shows that despite some recent marginal increases, the overall poverty rate appears to be falling in most countries. Although there are some periods when poverty increases despite improvement in financial inclusion. Overall, Fig. 2 suggests a negative association between financial inclusion and poverty.

5 Empirical examination of the poverty–financial inclusion relationship

5.1 Model specification, data, and method

We collect data from the IMF’s Financial Access Survey (FAS) to construct the composite financial index. We also use the IMF’s financial development index database for financial development indicator, the UNDP database for gender inequality index (GII), the World Bank’s World Governance Indicator (WGI) for the “Rule of law” variable, and the World Bank’s World Development Indicators (WDI) for most other control variables. The list of variables, their definitions, and data sources are presented in Table 2.

The dataset in this study includes 156 countries from 2004 to 2019. Table 3 presents the descriptive statistics of the key variables. Log poverty headcount at USD 1.9 per day, which measures the proportion of people living on less than USD 1.9 per day, is our dependent variable which we use as a proxy to measure extreme poverty. Similarly, we use log poverty headcount at USD 3.2 per day to measure moderate poverty. Table 3 presents that the log poverty headcount has a significant standard deviation, indicating that poverty levels in countries vary significantly. Our primary independent variable is a financial inclusion index with values between 0.094 and 1. Among the control variables, GDP growth per capita has the widest dispersion.

We apply the dynamic two-stage system generalized method of moments (GMM) panel estimation method to this data set. As the two-stage system GMM method uses both level and lag value of the variables as instruments, it is more suitable for addressing the endogeneity and serial correlation issues than the fixed-effect method. Our model specification for the system GMM method is shown in Eq. (5).

$$\ln povheadl_{it} = \alpha + \beta_1 \ln povheadl_{it-1} + \beta_2 FII_{it} + \gamma Z_{it} + \varepsilon_{it} \quad (5)$$

where the dependent variable is the log poverty headcount ratio at USD 1.9 per day ($\ln povheadl_{it}$), which is a measure of extreme poverty. The composite financial inclusion index (FII_{it}) is an independent variable. The lag-dependent variable ($\ln povheadl_{it-1}$) is used as a separate independent variable, as per the specification of the system GMM method. Z is a vector of control variables, including GDP growth per capita, log Gini, school enrollment, and the rule of law.⁵

We expect a negative coefficient for the financial inclusion index, indicating that financial inclusion can reduce extreme poverty. We select the control variables from previous studies (Gutiérrez-Romero and Ahamed 2021; Omar and Inaba 2020; Park and Mercado 2018), but we apply dynamic panel analysis instead of static analysis in earlier studies. GDP growth per capita assesses the impact of income growth on poverty, and log Gini captures the impact of the unequal income distribution.

⁵ Omar and Inaba (2020) use financial development as a control variable. Due to the potential multicollinearity problem, we do not include financial development. However, our examination suggests that the results of this study remain valid even if we include financial development.

Table 2 Definitions of variables and data sources

Variable name	Definition	Source
Extreme poverty	Log poverty headcount ratio at USD 1.9 per day measured in 2011 international prices	World Development Indicator (WDI), The World Bank (WB)
Moderate poverty	Log poverty headcount ratio at USD 3.2 per day measured in 2011 international prices	WDI, WB (2020)
Financial inclusion index (FII)	An equal weighted composite financial inclusion index. The index value remains between zero and one, where a higher value indicates higher financial inclusion	Authors' assessment. Financial Access Survey (FAS), IMF
GDP growth per capita	Real annual growth of GDP per capita measured in constant USD 2010 prices	WDI, WB (2020)
Log Gini	Log of Gini coefficient	WDI, WB (2020)
School enrollment	Log of gross secondary school enrollment ratio	WDI, WB (2020)
Gender inequality index (GII)	Composite index measuring gender inequality in terms of reproductive health, empowerment, and economic status. The value remains between zero and one where a lower value indicates greater gender equality	United Nations Development Project, UN
Rule of law	Perceptions of the extent to which agents have confidence in and abide by the rules of society, country's score ranging from approximately -2.5 to 2.5	World Governance Indicators (WGI), WB

Table 3 Descriptive statistics of the key variables: all countries

Variable	Observation	Mean	Std. deviation	Minimum	Maximum
Log poverty headcount at USD 1.9	1074	0.431	1.838	− 2.303	4.546
Log poverty headcount at USD 3.2	1175	1.167	2.013	− 2.303	4.590
Financial inclusion index	3008	0.851	0.103	0.094	1
Gender inequality index	1703	0.369	0.189	0.03	0.82
GDP growth per capita	3226	2.22	5.136	− 62.378	121.779
Log Gini	1240	3.581	0.213	3.144	4.171
School enrollment	2277	4.336	0.461	1.780	5.099
Rule of law	3256	− 0.029	0.995	− 2.606	2.10

Source: World Development Indicators (WDI), World Governance Indicators (WGI), The World Bank, Financial Access Survey (FAS), The IMF. Computation of Financial Inclusion Index: Authors' calculation

We expect GDP growth to have a negative coefficient because higher income should reduce poverty. Log Gini is expected to have a positive coefficient because higher inequality in income distribution disproportionately favors the rich and is detrimental to poverty reduction. We use school enrollment as a proxy for human capital development and expect a negative coefficient. In addition, the rule of law is chosen as a proxy for institutional quality. Adherence to the rule of law should enable poverty reduction by ensuring the smooth functioning of regulatory mechanisms.

Though we primarily apply the system GMM method for our analysis, we also checked the robustness of our results based on the static (fixed-effect) regression method. Data requirements of the system GMM method make it difficult to analyze the above model for a wide range of countries. In contrast, the fixed-effect method enables the analysis of many countries. Though the fixed-effect method is less suited to address endogeneity than the system GMM method, it is otherwise suitable for analyzing panel data, as it controls for country-specific influence by incorporating country fixed effect. Previous studies by Gutiérrez-Romero and Ahamed (2021), Omar and Inaba (2020), and Park and Mercado (2018) have also applied this method in analyzing poverty–financial inclusion linkage. We apply the fixed-effect estimation technique in this study primarily for checking robustness. The model specification of this method is shown in Eq. (6).

$$\ln povheadl_{it} = \alpha + \beta_1 FII_{it} + \gamma Z_{it} + \eta_i + \varepsilon_i \quad (6)$$

where η_i is the country fixed-effect coefficient and control variables in vector Z_{it} are the same as in Eq. (5). In addition to examine the effects of gender inequality, we include the GII as a control variable in this model. The interaction between the financial inclusion index and gender inequality is also included.

Before conducting the empirical regression analysis, we perform several statistical tests. We have an unbalanced panel database with missing values; thus, we apply Fisher-type unit root tests with Phillips–Perron criteria to assess the stationarity properties of the variables. We find that almost all of the variables are stationary at level. To check multicollinearity, we examine the correlation matrix for different income groups

Table 4 Extreme poverty and financial inclusion in developing countries: dynamic two-stage system GMM panel method

Time frame: 2004–2019, yearly panel

Variables	(1)	(2)	(3)	(4)
	Dependent variable: log poverty headcount ratio at USD 1.9 per day			
Lag-dependent variable	0.168 (0.251)	−0.157 (0.207)	0.0141 (0.173)	0.0305 (0.172)
Financial inclusion index	−16.46*** (5.147)	−15.82*** (3.745)	−9.348*** (2.517)	−8.706*** (2.085)
GDP growth per capita	−0.0343* (0.0194)	−0.0162 (0.0122)	−0.00889 (0.0106)	−0.0102 (0.00955)
Log Gini		4.930*** (1.355)	3.444*** (1.088)	3.348*** (1.025)
School enrollment			−0.920 (0.798)	−1.286 (0.798)
Rule of law				0.315 (0.256)
Constant	15.64*** (4.765)	−3.002 (4.360)	0.734 (4.240)	2.263 (4.074)
Observations	332	332	275	275
<i>Diagnostic tests</i>				
Number of countries	35	35	33	33
No. of instruments	29	30	31	32
AR2 statistics	0.177	0.214	0.196	0.155
Hansen J score	0.370	0.257	0.331	0.418

Dynamic twostage system GMM panel method. The first column analyzes the impact of financial inclusion on poverty using GDP growth per capita as a control variable. In models (2), (3), and (4), we add log Gini, school enrollment, and the rule of law as additional control variables, respectively. Significance, *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. Robust standard errors are in parentheses

of countries. As correlations appear to be moderate in most cases, we assume that multicollinearity problem is not an issue for our study. We perform the Hausman test to determine the appropriate static model, finding that the fixed-effect model is appropriate. We apply the panel Granger causality test and find that financial inclusion Granger causes poverty, and there is no reverse causality. We perform the modified Wald test and find heteroskedasticity in the data. To rectify the issue, we use robust standard errors.

5.2 Empirical results

5.2.1 Impact of financial inclusion on extreme poverty

Table 4 presents the results obtained using the system GMM method. The diagnostic tests indicate that all GMM requirements are satisfied and the model is well

Table 5 Extreme poverty and financial inclusion in developing countries: fixed-effects method

Time frame: 2004–2019, yearly panel

Variables	(1)	(2)	(3)	(4)	(5)
Dependent variable: log poverty headcount ratio at USD 1.9 per day					
Financial inclusion index	−6.676*** (1.174)	−6.686*** (1.227)	−5.279*** (1.121)	−4.050*** (0.872)	−3.780*** (0.927)
GDP growth per capita		0.00838 (0.00751)	0.000567 (0.00626)	−0.0138** (0.00540)	−0.0140*** (0.00525)
Log Gini			4.495*** (0.766)	3.381*** (0.643)	3.377*** (0.635)
School enrollment				−1.384*** (0.303)	−1.346*** (0.306)
Rule of law					−0.266 (0.300)
Constant	7.140*** (1.006)	7.128*** (1.056)	−10.66*** (3.116)	−1.675 (3.268)	−2.182 (3.297)
Observations	609	603	603	431	431
R-squared	0.231	0.235	0.412	0.432	0.436
Number of countries	114	113	113	94	94

Panel fixed-effect method. Significance, *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. Robust standard errors are in parentheses

specified.⁶ Even after incorporating all the relevant control variables, financial inclusion has a significant negative coefficient, suggesting that financial inclusion has negative association with poverty in developing countries. This result is congruent with the findings of previous cross-country studies (Park and Mercado 2018; Swamy 2010; Omar and Inaba 2020). Previous studies, such as Demircuc-Kunt et al. (2017) and Aker et al. (2014), argue that financial inclusion seems to expand opportunities to involuntarily excluded portions of society by offering credit, savings, insurance, and digital financial services, which smoothens consumption, increases efficiency, and raises labor force participation, leading to poverty reduction. The results in Table 4 align with these arguments.

Among other variables, log Gini has a significant and positive coefficient, and GDP growth per capita has expected negative coefficients though the coefficient is not always significant. These results indicate that countries can reduce poverty by lowering income inequality and expanding GDP growth.

⁶ In Table 4, the number of countries is greater than the number of instruments. Moreover, the null hypothesis of no second-order autocorrelation cannot be rejected. Similarly, the null hypothesis of no over-identification problem cannot be rejected. These tests results confirm that the dynamic two-stage system GMM panel method is applicable for our analysis.

Table 6 Extreme poverty and financial inclusion: various groups of countries (GMM)

Time frame: 2004–2019, yearly panel

Variables	(All countries)	(High-income countries)	(Upper-middle-income countries)	(Lower-middle-income and low-income countries)
Dependent variable: log poverty headcount ratio at USD 1.9 per day				
Lag-dependent variable	0.430* (0.255)	0.568*** (0.113)	0.297* (0.167)	1.189 (1.194)
Financial inclusion index	-5.404* (2.991)	4.409 (5.512)	-6.311* (3.119)	-2.071 (1.870)
GDP growth per capita	-0.0194** (0.00869)	-0.0199** (0.00920)	-0.0122 (0.0106)	-0.00715 (0.0452)
Log Gini	1.820** (0.874)	1.074** (0.439)	1.876** (0.673)	0.748 (3.168)
School enrollment	-0.367 (0.552)	-0.530 (0.373)	-0.707 (1.283)	1.609 (1.456)
Rule of law	-0.273 (0.191)	-0.219 (0.190)	0.146 (0.289)	0.120 (2.311)
Constant	0.260 (2.667)	-5.542 (5.379)	2.737 (4.792)	-8.259
Observations	610	253	210	65
Diagnostic tests				
Number of countries	65	30	24	9
Number of instruments	32	27	32	31
AR2 statistics	0.644	0.110	0.167	0.479
Hansen J score	0.367	0.698	0.789	1.000

Dynamic two-stage system GMM panel method. All countries include high-income, upper-middle-income, lower-middle-income, and low-income countries. Significance, *** $p < 0.01$, and ** $p < 0.05$, * $p < 0.1$. Robust standard errors are in parentheses

In Table 5, we present the results of the fixed-effect analysis, in which the number of countries is much larger than in the system GMM analysis. Even after incorporating all the control variables, the financial inclusion index has a statistically significant negative coefficient. This result supports our findings using the system GMM method and aligns with previous studies (Park and Mercado 2018; Swamy 2010). Among the control variables, log Gini is significant with a positive coefficient, while school enrollment is also significant with expected negative sign. Increased school enrollment is likely to contribute to poverty eradication by improving human resources and cultivating improved skills for boosting productivity.

Table 6 presents the results of system GMM analysis for different income groups of countries. This analysis is essential because financial inclusion and other control variables might affect countries in various stages of development differently. Classifying countries according to their income levels allows us to assess the impact of

Table 7 Extreme poverty and financial inclusion: various groups of countries (fixed-effect method)

Time frame: 2004–2019, yearly panel

Variables	(All countries)	(High-income countries)	(Upper-middle-income countries)	(Lower-middle-income and low-income countries)
Dependent variable: log poverty headcount ratio at USD 1.9 per day				
Financial inclusion index	−3.574*** (0.841)	−4.115 (2.102)	−4.999*** (1.445)	−2.357* (1.298)
GDP growth per capita	−0.0127*** (0.00415)	−0.0126** (0.00601)	−0.0189** (0.00707)	−0.0129 (0.0107)
Log Gini	3.794*** (0.500)	4.566*** (0.785)	2.958*** (0.956)	3.746*** (0.747)
School enrollment	−1.160*** (0.273)	−0.580 (0.581)	−1.919*** (0.488)	−1.024*** (0.300)
Rule of law	−0.508** (0.240)	−0.784** (0.378)	−0.255 (0.360)	−0.0375 (0.439)
Constant	−4.831* (2.771)	−9.408* (4.849)	2.945 (5.628)	−5.586** (2.745)
Observations	816	385	254	177
R-squared	0.345	0.251	0.469	0.446
Number of countries	133	39	33	61

Panel fixed-effect method. “All countries” includes high-income, upper-middle-income, lower-middle-income, and low-income countries. Significance, *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. Robust standard errors in parentheses

financial inclusion on countries in similar stages of development. The system GMM results in Table 6 demonstrate that financial inclusion has negatively coefficients with poverty in all countries case, upper-middle-income countries, and lower-middle-income and low-income countries, but not for high-income countries.⁷ These results broadly support our earlier findings in Table 4. In high-income countries, financial inclusion seems not to have a significant association, or an expected negative coefficient. Since high-income countries have very low existing extreme poverty rates, further poverty reduction through financial inclusion seems challenging.

Table 7 adopts the fixed-effect method to investigate the impact of financial inclusion on poverty in different income groups of countries, thus finding that financial inclusion has a significant negative correlation with extreme poverty in all countries case, in upper-middle-income countries, and in lower-middle-income and low-income countries, but not in high-income countries. Among the income-based country groups with significant coefficients, the significance level and magnitude of financial inclusion coefficient in lower-middle-income and low-income countries

⁷ This method cannot evaluate lower-middle-income and low-income countries due to the limitation of data (the number of countries is smaller than the number of instruments).

are weaker than in upper-middle-income countries. Inequality in accessing financial services could explain this issue. As lower-middle-income and low-income countries have lower levels of financial inclusion and higher gender inequality than upper-middle-income countries, financial inclusion has a weaker association with poverty in lower-middle-income and low-income countries.⁸ Moreover, lower-middle-income and low-income countries have lower average income and lower school enrollment levels than upper-middle-income countries.⁹ Kara et al. (2021) indicated that people with less income, education, and financial literacy are less likely to access financial services. So, we can argue that financial services are likely to be more unequally shared in lower-middle-income and low-income countries than in upper-middle-income countries. In summary, Tables 6 and 7 confirm that financial inclusion has different levels of association with poverty in different income groups of countries, and it does not have a significant association in high-income countries.

5.2.2 Impact of financial inclusion on moderate poverty

In this section, we examine the effect of financial inclusion on moderate poverty, defined as the log of poverty headcount ratio at USD 3.2 per day, as per 2011 purchasing power parity estimates. Table 8 presents the system GMM results for different income groups of countries. Financial inclusion has a significant negative coefficient only for developing countries. This suggests that reducing moderate poverty through financial inclusion by raising national incomes to a higher level is more challenging than improving extreme poverty.

Table 9 analyzes the impact of financial inclusion on moderate poverty using the fixed-effect method, revealing that financial inclusion has a negative association with moderate poverty in each income group of countries, except high-income countries. However, the magnitude of the negative coefficient is weaker in Table 9 than the extreme poverty case in Table 7, suggesting that moderate poverty is harder to alleviate through financial inclusion than extreme poverty. In summary, from Tables 8 and 9, we can conclude that financial inclusion has significant negative association with moderate poverty, particularly in the case of developing countries, and our previous findings are robust.

5.2.3 Impact of gender inequality in poverty reduction through financial inclusion

In this section, we investigate the influence of unequal access to financial services. Kara et al. (2021) show that financial services are not equally accessible among less educated people, women, and other vulnerable groups. If financial inclusion cannot

⁸ The average gender inequality index (GII) score is 0.377 in upper-middle-income countries and 0.529 in lower-middle-income and low-income countries, suggesting more gender equality in upper-middle-income countries. Panel B of Fig. 1 indicates that upper-middle-income countries also have a higher financial inclusion level.

⁹ In upper-middle-income countries, average gross secondary school enrollment ratio is 89.19% and per capita GDP is USD 6483. In lower-middle-income and low-income countries, average school enrollment is 54.89% and per capita GDP is USD 1,532.

Table 8 Moderate poverty and financial inclusion: various group of countries (GMM)

Variables	Dependent: log poverty headcount at USD 3.2 per day			
	(All countries)	(High-income countries)	(Developing countries)	(Upper-middle-income and low-income countries)
Lag – dependent variable	0.909*** (0.190)	0.845*** (0.244)	0.679*** (0.105)	0.733*** (0.127)
Financial inclusion index	–1.818 (1.878)	4.456 (5.258)	–3.405** (1.442)	–2.102 (1.646)
GDP growth per capita	–0.0205*** (0.00659)	–0.0213* (0.0115)	–0.00940** (0.00447)	–0.00980 (0.00575)
Log Gini	0.526 (0.667)	0.710 (0.839)	1.133** (0.464)	0.810 (0.502)
School enrollment	–0.0570 (0.215)	–0.258 (0.402)	–0.674* (0.352)	–0.780 (0.591)
Rule of law	0.00574 (0.135)	–0.123 (0.212)	0.257* (0.140)	0.153 (0.198)
Constant	0.0940 (0.537)	–5.398 (4.563)	2.634 (1.913)	2.907 (2.951)
Observations	700	389	311	234
<i>Diagnostic tests</i>				
Number of Countries	68	34	34	25
Number of instruments	32	32	32	32
AR2 statistics	0.159	0.246	0.153	0.432
Hansen J score	0.526	0.296	0.696	0.830

Dynamic two-stage system GMM panel method. “All countries” include high-income, upper-middle-income, and low-income countries. “Developing countries” include upper-middle-income, lower-middle-income and low-income countries. Significance, ***p < 0.01, **p < 0.05, and *p < 0.1. Robust standard errors are in parentheses

Table 9 Moderate poverty and financial inclusion: various group of countries (fixed-effect method)

Time frame: 2004–2019, yearly panel

Variables	(All countries)	(High-income countries)	(Developing countries)	(Upper-middle-income countries)	(Lower-middle-income and low-income countries)
Dependent: Log poverty headcount at USD 3.2 per day					
Financial inclusion index	-2.349*** (0.609)	-1.757 (1.452)	-2.711*** (0.608)	-3.474*** (0.943)	-1.604** (0.612)
GDP growth per capita	-0.00813** (0.00399)	-0.0103 (0.00617)	-0.00551 (0.00396)	-0.0117** (0.00561)	-0.00181 (0.00502)
Log Gini	3.575*** (0.550)	4.554*** (0.969)	3.028*** (0.652)	3.200*** (0.888)	2.725*** (0.808)
School enrollment	-0.923*** (0.280)	-0.585 (0.516)	-1.052*** (0.315)	-1.828*** (0.562)	-0.519*** (0.178)
Rule of law	-0.397* (0.224)	-0.681* (0.348)	-0.144 (0.258)	-0.228 (0.327)	0.268 (0.215)
Constant	-5.453*** (2.524)	-11.21** (4.728)	-1.937 (2.859)	1.378 (4.484)	-3.274 (3.122)
Observations	899	435	464	277	187
R-squared	0.317	0.239	0.427	0.529	0.382
Number of countries	134	39	95	34	61

Panel fixed-effect method. "All countries" include high-income, upper-middle-income, lower-middle-income, and low-income countries. "Developing countries" include upper-middle-income, lower-middle-income and low-income countries. Significance, *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. Robust standard errors are in parentheses

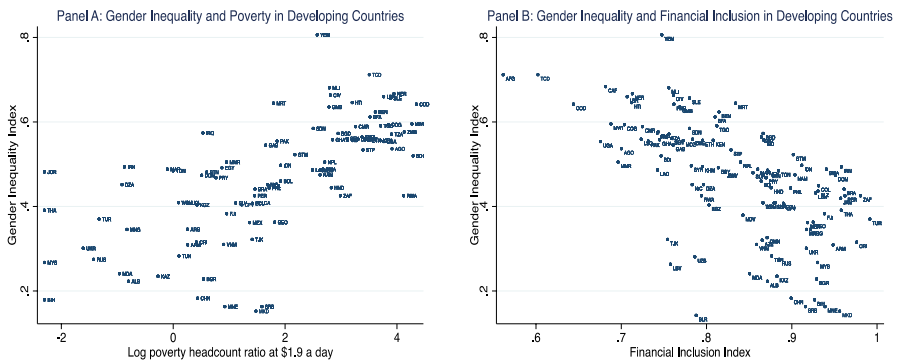


Fig. 3 Gender inequality, poverty, and financial inclusion in developing countries

reach its target group, it is difficult to use this tool for poverty alleviation. In this study, we focus on gender inequality because women are one of the key groups that lack access to financial products (Aslan et al. 2017; Sandhu et al. 2012).

According to United Nations Development Programme (UNDP), gender equality measures women’s reproductive health, empowerment, and economic status. As a measure of gender inequality, we use the gender inequality index, whose scores range between 0 and 1 with higher scores indicating higher gender inequality. Panel A of Fig. 3 shows that countries with higher poverty levels generally have higher gender inequality. Panel B suggests that countries with higher financial inclusion tend to have low gender inequality despite the substantial country variation.

High gender inequality also indicates poor health, lower school enrollment, and lower labor force participation by women. So, if gender inequality is reduced, women can capitalize on the benefits of financial inclusion by engaging more in economic activities, which should positively affect poverty reduction. We apply conditional analysis and use the interaction of gender inequality index and financial inclusion to examine this idea.¹⁰ The results are presented in Table 10.

Table 10 evaluates the impact of financial inclusion and gender inequality for moderate and extreme poverty in developing countries. In both cases, the interaction terms have significant positive coefficients, suggesting that a higher level of gender inequality will reduce financial inclusion’s association with poverty reduction. The net effect of financial inclusion ($-9.195 + 15.79 \times \text{GII}$ for moderate poverty and $-12.42 + 20.87 \times \text{GII}$ for extreme poverty) suggests that lowering gender inequality may improve the reduction of poverty through financial inclusion. The net effect is robust because financial inclusion and its interactions with gender inequality variables are also jointly significant. These findings support the arguments of previous researchers about the influence of gender inequality on the impact of financial inclusion (Kara et al. 2021; Aslan et al. 2017).

¹⁰ Other aspects of inequality in financial services could be investigated in the future when high-frequency data on such aspects become available for analysis.

Table 10 Conditional analysis: impact of gender inequality and financial inclusion on poverty (developing countries, fixed-effect method)

Poverty level	(1)	(2)
	Moderate poverty	Extreme poverty
Financial inclusion index (FII)	−9.195*** (1.631)	−12.42*** (4.521)
Gender inequality index (GII)	−9.700 (2.692)	−12.06 (7.251)
FII × GII	15.79*** (3.610)	20.87** (8.632)
GDP growth per capita	0.00192 (0.00734)	−0.0132 (0.00943)
Log Gini	3.739*** (0.942)	4.216*** (0.968)
Rule of law	−0.158 (0.221)	−0.272 (0.239)
Inflation	0.0357 (0.0335)	0.0122 (0.0359)
Constant	−5.117 (3.744)	−5.987 (5.425)
Observations	397	359
R – squared	0.584	0.551
Number of countries	94	91
Joint significance	16.95***	4.71**

Panel fixed-effect method. Gender inequality index (GII) has a score between zero and one where low score indicates more gender equality. Significance, *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. Robust standard errors are in parentheses

5.3 Discussion

Our findings have several practical implications for different agents and countries. As panel B of Fig. 1 indicates that financial services have not yet reached all groups of people in developing countries, we recommend that financial institutions expand their business by offering customized financial services that meet the need of the users. To encourage financial institutions to expand financial services to women or the poor, central banks and other regulators of the financial market should design policies that reward financial institutions that provide financial services to the disadvantaged group. Since we find a significant negative association between financial inclusion and poverty, we recommend that governments in developing countries utilize financial inclusion initiatives such as digital transfer of financial assistance or expanding SME loans to counter the recent surge in poverty caused by the covid-19 pandemic. As we find that reducing gender inequality supports poverty reduction through financial inclusion initiatives, Governments should take initiatives to promote gender equality by increasing education and employment opportunities for women. Our results also suggest

that the impact of financial inclusion is more prominent in upper-middle-income countries. So, we recommend that lower-middle-income and low-income countries adopt policies that expand the reach of financial inclusion by encouraging the disadvantaged group to use financial services.

Financial inclusion expands opportunities for the poor by enabling them to access and use financial services. The use of financial services may reduce poverty by stimulating the income of the poor or by achieving cost savings or efficiency gains that allow the poor to increase their household spending. Studies identify that financial inclusion can boost the income of the poor by financing new business establishments (Kara et al. 2021); enabling the poor to take on more risk by offering insurance services (Karlan et al. 2014; Cole et al. 2013); and expanding employment opportunities, especially for women (Cabeza et al. 2019; El-Zoghbi et al. 2019). Savings and digital financial services may also reduce poverty by allowing households to save more and smooth consumption (Demirguc-Kunt et al. 2017). Though the study cannot establish which causal channel works for developing countries, the results suggest a significant negative association between financial inclusion and poverty. Moreover, the study also reveals that the association between financial inclusion and poverty varies with the countries' income levels. Due to a higher level of economic development, countries with higher income usually have a higher demand for and supply of financial services, enabling more people to be financially included and perhaps inducing faster poverty reduction.

The study has one possible limitation. Though our analysis suggests some probable channels, it could not specify the exact causal channels through which financial inclusion affects poverty. This issue can be investigated in the future when we have more information available on how the poor in developing countries utilize financial services.

6 Conclusion

In this study, we construct a novel composite financial inclusion index. Applying the two-stage system GMM and fixed-effect methods, we explore how financial inclusion affects poverty in countries classified into different income groups. We also examine the impact of financial inclusion on extreme and moderate poverty. The results suggest that financial inclusion has a significant negative association with extreme poverty in developing countries but not in high-income countries. Moreover, the coefficient of financial inclusion is smaller in lower-middle-income and low-income countries than in upper-middle-income countries. Inequality in accessing financial services could be the reason behind the variation in results. Low-income countries are expected to have higher inequality in access to financial services; therefore, the coefficient of financial inclusion is weaker in these countries. We also find that the association between financial inclusion and moderate poverty is weaker than that of extreme poverty. Finally, we found that lowering gender inequality may improve poverty reduction through financial inclusion. These findings suggest that improving financial inclusion alone is insufficient to increase the income levels of the poor substantially. Especially in lower-middle-income and low-income

countries, an important precondition is to make financial services more accessible to disadvantaged groups.

Appendix

Appendix A: List of countries included in the sample

Low Income Countries

Burkina Faso, Burundi, Central African Republic, Chad, Congo Democratic Republic, Ethiopia, Gambia, Guinea, Guinea

Bissau, Haiti, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, South Sudan, Sudan, Syrian Arab Republic, Tajikistan, Togo, Uganda, Yemen, Rep

Lower Middle Income Countries

Algeria, Angola, Bangladesh, Benin, Bhutan, Bolivia, Cabo Verde, Cameroon, Comoros, Congo, Cote d'Ivoire, Djibouti, Egypt, El Salvador, Eswatini, Ghana, Honduras, India, Kenya, Kiribati, Kyrgyz Republic, Lao PDR, Lesotho, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Myanmar, Nepal, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Philippines, Sao Tome, Senegal, Solomon Islands, Sri Lanka, Tanzania, Timor

Leste, Tunisia, Ukraine, Vanuatu, Vietnam, West Bank and Gaza, Zambia, Zimbabwe

Upper Middle Income Countries

Albania, Argentina, Armenia, Belarus, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Dominican Republic, Ecuador, Fiji, Gabon, Georgia, Guatemala, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kosovo, Malaysia, Maldives, Mexico, Montenegro, Namibia, North Macedonia, Paraguay, Peru, Russian Federation, Samoa, Serbia, South Africa, St. Lucia, Thailand, Tonga, Turkey, Tuvalu, Venezuela

High Income Countries

Australia, Austria, Belgium, Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malta, Mauritius, Netherlands, Norway, Panama, Poland, Portugal, Romania, Seychelles, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States, Uruguay

Appendix B: Composite financial inclusion index (FII). (Constructed for all but only scores of developing countries are reported)

SL	Country	04	05	06	07	08	09	10	11	12	13
1	Afghanistan	0.094	0.148	0.149	0.151	0.670	0.671	0.602	0.601	0.608	0.605

SL	Country	04	05	06	07	08	09	10	11	12	13
2	Albania	0.693	0.725	0.764	0.788	0.830	0.838	0.851	0.858	0.865	0.862
3	Algeria	0.816	0.778	0.782	0.789	0.791	0.782	0.788	0.794	0.798	0.800
4	Angola	0.733	0.736	0.743	0.749	0.756	0.765	0.774	0.783	0.792	0.697
5	Argentina	0.805	0.828	0.844	0.863	0.879	0.890	0.900	0.913	0.925	0.934
6	Armenia	0.710	0.737	0.760	0.824	0.857	0.857	0.888	0.926	0.957	0.973
7	Azerbaijan	0.828	0.748	0.752	0.781	0.799	0.777	0.803	0.834	0.869	0.905
8	Bangladesh	0.840	0.841	0.842	0.841	0.843	0.844	0.851	0.857	0.860	0.863
9	Belarus	0.776	0.793	0.806	0.828	0.840	0.848	0.858	0.864	0.872	0.879
10	Belize	0.864	0.885	0.946	0.953	0.959	0.964	0.964	0.943	0.939	0.932
11	Benin	0.849	0.841	0.839	0.825	0.924	0.923	0.886	0.838	0.822	0.867
12	Bhutan	0.731	0.689	0.694	0.704	0.719	0.732	0.783	0.820	0.741	0.840
13	Bolivia	0.814	0.811	0.823	0.778	0.750	0.770	0.789	0.818	0.829	0.841
14	Bosnia and Herzego- vinian	0.804	0.817	0.812	0.896	0.909	0.924	0.917	0.923	0.926	0.929
15	Botswana	0.911	0.916	0.926	0.956	0.960	0.961	0.952	0.940	0.937	0.933
16	Brazil	0.875	0.916	0.920	0.908	0.920	0.938	0.948	0.949	0.961	0.963
17	Bulgaria	0.830	0.902	0.922	0.932	0.935	0.934	0.931	0.929	0.931	0.931
18	Burkina Faso	0.828	0.828	0.828	0.983	0.982	0.988	0.869	0.869	0.867	0.878
19	Burundi	0.606	0.608	0.612	0.696	0.702	0.713	0.719	0.723	0.732	0.735
20	Cabo Verde	0.775	0.784	0.802	0.825	0.843	0.853	0.862	0.867	0.860	0.858
21	Cambodia	0.828	0.729	0.733	0.735	0.653	0.659	0.664	0.789	0.794	0.799
22	Cameroon	0.760	0.760	0.764	0.767	0.769	0.610	0.732	0.624	0.629	0.634
23	Central African Rep	0.730	0.667	0.668	0.671	0.627	0.629	0.632	0.635	0.636	0.639
24	Chad	0.730	0.730	0.730	0.730	0.668	0.731	0.669	0.670	0.670	0.600
25	China	0.828	0.828	0.705	0.714	0.725	0.738	0.752	0.766	0.906	0.917
26	Colombia	0.858	0.876	0.895	0.898	0.934	0.915	0.920	0.922	0.935	0.941
27	Comoros	0.674	0.741	0.738	0.744	0.785	0.804	0.724	0.739	0.738	0.738
28	Congo, Dem. Rep	0.734	0.734	0.729	0.737	0.737	0.629	0.596	0.606	0.613	0.614
29	Congo, Rep	0.670	0.671	0.672	0.675	0.630	0.634	0.637	0.640	0.643	0.676
30	Costa Rica	0.905	0.933	0.959	0.967	0.964	0.967	0.966	0.972	0.973	0.980
31	Cote d'Ivoire	0.828	0.828	0.828	0.828	0.828	0.828	0.746	0.749	0.748	0.754
32	Djibouti	0.733	0.733	0.734	0.734	0.606	0.615	0.623	0.626	0.632	0.667
33	Dominica	0.809	0.815	0.815	0.803	0.815	0.854	0.841	0.873	0.872	0.877
34	Dominican Republic	0.917	0.933	0.899	0.914	0.920	0.926	0.932	0.940	0.936	0.944
35	Egypt, Arab Rep	0.741	0.708	0.705	0.718	0.732	0.736	0.743	0.728	0.733	0.766
36	El Salvador	0.851	0.858	0.866	0.862	0.869	0.860	0.848	0.860	0.860	0.863
37	Equatorial Guinea	0.634	0.637	0.639	0.608	0.613	0.617	0.619	0.629	0.637	0.629
38	Eswatini	0.776	0.801	0.815	0.837	0.880	0.880	0.886	0.826	0.849	0.877
39	Ethiopia	0.729	0.779	0.710	0.714	0.712	0.720	0.721	0.726	0.727	0.829
40	Fiji	0.827	0.843	0.868	0.861	0.880	0.877	0.891	0.901	0.904	0.920
41	Gabon	0.829	0.629	0.635	0.640	0.652	0.655	0.664	0.674	0.702	0.799
42	Gambia, The	0.823	0.773	0.774	0.775	0.792	0.791	0.781	0.797	0.795	0.706
43	Georgia	0.695	0.731	0.801	0.874	0.913	0.920	0.932	0.940	0.949	0.942
44	Ghana	0.721	0.737	0.740	0.740	0.715	0.716	0.726	0.730	0.675	0.681

SL	Country	04	05	06	07	08	09	10	11	12	13
45	Grenada	0.849	0.854	0.856	0.862	0.868	0.871	0.875	0.873	0.855	0.870
46	Guatemala	0.796	0.830	0.855	0.879	0.891	0.890	0.893	0.898	0.908	0.912
47	Guinea	0.660	0.662	0.663	0.664	0.679	0.683	0.692	0.736	0.741	0.763
48	Guinea-Bissau	0.829	0.829	0.829	0.829	0.829	0.829	0.736	0.736	0.739	0.747
49	Guyana	0.756	0.763	0.751	0.768	0.793	0.802	0.810	0.822	0.825	0.828
50	Haiti	0.648	0.652	0.657	0.661	0.666	0.669	0.667	0.667	0.725	0.723
51	Honduras	0.779	0.785	0.790	0.821	0.822	0.844	0.847	0.872	0.886	0.887
52	India	0.855	0.812	0.815	0.821	0.828	0.831	0.844	0.846	0.852	0.859
53	Indonesia	0.801	0.807	0.807	0.837	0.857	0.865	0.871	0.885	0.901	0.912
54	Iran, Islamic Rep	0.977	0.870	0.886	0.905	0.920	0.935	0.959	0.971	0.984	0.989
55	Iraq	0.829	0.829	0.829	0.833	0.736	0.738	0.743	0.742	0.742	0.737
56	Jamaica	0.938	0.945	0.952	0.952	0.957	0.956	0.956	0.957	0.958	0.959
57	Jordan	0.823	0.826	0.829	0.826	0.827	0.837	0.821	0.820	0.820	0.817
58	Kazakhstan	0.772	0.791	0.808	0.856	0.880	0.884	0.888	0.890	0.891	0.892
59	Kenya	0.645	0.654	0.676	0.696	0.715	0.735	0.756	0.748	0.752	0.795
60	Kiribati	0.829	0.829	0.829	0.829	0.829	0.829	0.829	0.652	0.653	0.679
61	Kosovo	0.753	0.737	0.751	0.784	0.818	0.837	0.848	0.866	0.867	0.852
62	Kyrgyz Republic	0.673	0.675	0.675	0.679	0.687	0.718	0.719	0.741	0.755	0.771
63	Lao PDR	0.829	0.829	0.829	0.829	0.741	0.691	0.701	0.709	0.717	0.708
64	Lebanon	0.846	0.888	0.901	0.913	0.924	0.930	0.933	0.933	0.933	0.929
65	Lesotho	0.681	0.706	0.716	0.728	0.690	0.696	0.683	0.699	0.695	0.719
66	Liberia	0.829	0.829	0.829	0.829	0.635	0.648	0.656	0.657	0.663	0.665
67	Libya	0.752	0.750	0.749	0.747	0.749	0.774	0.778	0.765	0.746	0.746
68	Madagascar	0.650	0.654	0.654	0.658	0.716	0.718	0.727	0.725	0.728	0.732
69	Malawi	0.636	0.636	0.639	0.650	0.644	0.654	0.658	0.680	0.677	0.677
70	Malaysia	0.883	0.883	0.884	0.910	0.913	0.923	0.924	0.923	0.923	0.944
71	Maldives	0.745	0.786	0.793	0.829	0.826	0.805	0.797	0.843	0.840	0.829
72	Mali	0.829	0.829	0.829	0.829	0.829	0.829	0.742	0.744	0.744	0.747
73	Marshall Islands	0.829	0.829	0.829	0.742	0.742	0.742	0.742	0.755	0.755	0.755
74	Mauritius	0.902	0.907	0.911	0.919	0.921	0.923	0.932	0.936	0.935	0.935
75	Mexico	0.846	0.853	0.865	0.872	0.901	0.906	0.917	0.908	0.918	0.922
76	Micronesia, Fed. Sts	0.715	0.716	0.717	0.715	0.713	0.720	0.747	0.749	0.767	0.766
77	Moldova	0.784	0.806	0.822	0.845	0.859	0.849	0.851	0.821	0.828	0.835
78	Mongolia	0.816	0.836	0.846	0.874	0.853	0.856	0.867	0.890	0.906	0.914
79	Montenegro	0.829	0.789	0.829	0.913	0.938	0.940	0.940	0.939	0.938	0.939
80	Morocco	0.831	0.848	0.845	0.854	0.862	0.812	0.818	0.826	0.834	0.840
81	Mozambique	0.680	0.643	0.651	0.686	0.693	0.709	0.719	0.740	0.755	0.773
82	Myanmar	0.650	0.651	0.651	0.651	0.651	0.651	0.652	0.651	0.624	0.643
83	Namibia	0.758	0.768	0.768	0.775	0.843	0.861	0.850	0.894	0.907	0.920
84	Nepal	0.829	0.829	0.829	0.829	0.829	0.829	0.829	0.839	0.812	0.822
85	Nicaragua	0.701	0.710	0.717	0.727	0.774	0.756	0.744	0.754	0.764	0.776
86	Niger	0.829	0.829	0.829	0.731	0.749	0.754	0.692	0.692	0.687	0.687
87	Nigeria	0.829	0.733	0.737	0.749	0.718	0.730	0.730	0.730	0.731	0.734

SL	Country	04	05	06	07	08	09	10	11	12	13
88	North Macedonia	0.740	0.715	0.800	0.889	0.961	0.961	0.963	0.962	0.959	0.959
89	Oman	0.824	0.830	0.836	0.843	0.850	0.854	0.881	0.884	0.881	0.885
90	Pakistan	0.660	0.665	0.676	0.692	0.696	0.697	0.700	0.702	0.709	0.717
91	Papua New Guinea	0.740	0.741	0.737	0.736	0.740	0.745	0.745	0.757	0.759	0.758
92	Paraguay	0.872	0.811	0.788	0.808	0.810	0.800	0.825	0.838	0.857	0.871
93	Peru	0.856	0.850	0.878	0.910	0.938	0.940	0.951	0.962	0.969	0.972
94	Philippines	0.846	0.853	0.859	0.860	0.866	0.869	0.875	0.884	0.885	0.897
95	Russian Federation	0.796	0.819	0.846	0.871	0.888	0.893	0.893	0.892	0.892	0.892
96	Rwanda	0.587	0.706	0.701	0.666	0.705	0.751	0.770	0.785	0.794	0.800
97	Samoa	0.807	0.826	0.823	0.828	0.832	0.836	0.843	0.886	0.873	0.884
98	Sao Tome and Principe	0.829	0.829	0.829	0.801	0.806	0.813	0.817	0.814	0.833	0.802
99	Senegal	0.829	0.829	0.829	0.829	0.829	0.829	0.747	0.750	0.751	0.751
100	Serbia	0.829	0.787	0.818	0.872	0.883	0.884	0.892	0.893	0.926	0.921
101	Sierra Leone	0.737	0.737	0.737	0.739	0.679	0.680	0.680	0.681	0.684	0.829
102	Solomon Islands	0.771	0.773	0.775	0.777	0.781	0.784	0.762	0.760	0.729	0.730
103	South Africa	0.911	0.915	0.929	0.941	0.960	0.971	0.977	0.982	0.991	0.993
104	South Sudan	0.829	0.829	0.829	0.829	0.829	0.829	0.829	0.591	0.592	0.594
105	Sri Lanka	0.919	0.917	0.921	0.849	0.861	0.870	0.880	0.890	0.895	0.929
106	St. Lucia	0.840	0.839	0.841	0.847	0.845	0.839	0.869	0.871	0.872	0.871
107	St. Vincent	0.812	0.812	0.815	0.827	0.826	0.822	0.829	0.829	0.809	0.844
108	Sudan	0.857	0.854	0.753	0.755	0.758	0.760	0.763	0.765	0.767	0.767
109	Suriname	0.760	0.764	0.780	0.787	0.790	0.797	0.776	0.775	0.778	0.778
110	Syrian Arab Republic	0.829	0.829	0.829	0.829	0.683	0.699	0.708	0.699	0.691	0.705
111	Tajikistan	0.733	0.679	0.697	0.716	0.722	0.715	0.720	0.736	0.750	0.768
112	Tanzania	0.829	0.829	0.646	0.662	0.634	0.637	0.644	0.654	0.655	0.654
113	Thailand	0.895	0.902	0.930	0.943	0.950	0.944	0.947	0.950	0.953	0.964
114	Timor-Leste	0.757	0.773	0.770	0.765	0.700	0.701	0.706	0.743	0.787	0.784
115	Togo	0.829	0.829	0.967	0.996	1.000	0.998	0.894	0.893	0.896	0.898
116	Tonga	0.908	0.931	0.896	0.886	0.900	0.895	0.889	0.890	0.890	0.912
117	Tunisia	0.751	0.869	0.884	0.894	0.900	0.905	0.913	0.920	0.850	0.856
118	Turkey	0.959	0.965	0.968	0.972	0.976	0.978	0.986	0.990	0.993	0.995
119	Uganda	0.688	0.701	0.705	0.707	0.710	0.715	0.646	0.652	0.643	0.646
120	Ukraine	0.810	0.875	0.888	0.905	0.917	0.918	0.919	0.921	0.922	0.921
121	Uzbekistan	0.627	0.636	0.654	0.668	0.681	0.687	0.715	0.716	0.730	0.744
122	Vanuatu	0.751	0.757	0.756	0.774	0.808	0.822	0.834	0.836	0.851	0.854
123	Venezuela, RB	0.829	0.847	0.874	0.892	0.895	0.897	0.904	0.905	0.906	0.905
124	Vietnam	0.738	0.744	0.747	0.765	0.782	0.793	0.803	0.841	0.856	0.864
125	West Bank and Gaza	0.829	0.829	0.764	0.774	0.797	0.792	0.802	0.827	0.835	0.839
126	Yemen, Rep	0.732	0.735	0.686	0.693	0.698	0.698	0.682	0.684	0.693	0.701
127	Zambia	0.699	0.703	0.709	0.720	0.742	0.708	0.679	0.719	0.738	0.760
128	Zimbabwe	0.779	0.757	0.718	0.695	0.687	0.702	0.716	0.733	0.763	0.782

SL	Country	14	15	16	17	18	19
1	Afghanistan	0.609	0.610	0.611	0.610	0.612	0.613
2	Albania	0.864	0.862	0.941	0.926	0.916	0.920
3	Algeria	0.800	0.802	0.799	0.798	0.802	0.807
4	Angola	0.704	0.708	0.710	0.721	0.714	0.646
5	Argentina	0.937	0.940	0.944	0.946	0.948	0.949
6	Armenia	0.987	0.990	0.992	0.993	0.996	0.998
7	Azerbaijan	0.916	0.894	0.890	0.888	0.887	0.887
8	Bangladesh	0.866	0.872	0.875	0.879	0.883	0.887
9	Belarus	0.883	0.706	0.705	0.706	0.704	0.705
10	Belize	0.934	0.929	0.937	0.925	0.933	0.922
11	Benin	0.854	0.821	0.828	0.730	0.741	0.737
12	Bhutan	0.859	0.873	0.885	0.887	0.946	0.960
13	Bolivia	0.851	0.861	0.920	0.926	0.930	0.934
14	Bosnia and Herzegovinian	0.931	0.932	0.930	0.929	0.929	0.929
15	Botswana	0.938	0.943	0.930	0.949	0.951	0.961
16	Brazil	0.973	0.973	0.973	0.974	0.975	0.975
17	Bulgaria	0.932	0.931	0.930	0.930	0.933	0.944
18	Burkina Faso	0.761	0.761	0.756	0.761	0.759	0.755
19	Burundi	0.746	0.743	0.726	0.828	0.828	0.828
20	Cabo Verde	0.880	0.888	0.888	0.888	0.894	0.899
21	Cambodia	0.808	0.816	0.825	0.833	0.842	0.852
22	Cameroon	0.748	0.751	0.753	0.754	0.762	0.828
23	Central African Rep	0.607	0.607	0.616	0.612	0.828	0.828
24	Chad	0.599	0.601	0.603	0.602	0.605	0.601
25	China	0.924	0.933	0.935	0.936	0.999	0.998
26	Colombia	0.941	0.942	0.941	0.942	0.944	0.945
27	Comoros	0.735	0.735	0.726	0.726	0.719	0.721
28	Congo, Dem. Rep	0.616	0.623	0.605	0.606	0.608	0.828
29	Congo, Rep	0.701	0.708	0.703	0.706	0.828	0.828
30	Costa Rica	0.983	0.982	0.985	0.987	0.990	0.989
31	Cote d'Ivoire	0.758	0.759	0.759	0.760	0.759	0.756
32	Djibouti	0.683	0.699	0.668	0.690	0.674	0.675
33	Dominica	0.874	0.866	0.862	0.855	0.854	0.850
34	Dominican Republic	0.951	0.963	0.966	0.966	0.965	0.968
35	Egypt, Arab Rep	0.767	0.773	0.833	0.851	0.871	0.888
36	El Salvador	0.872	0.899	0.901	0.904	0.904	0.904
37	Equatorial Guinea	0.634	0.648	0.657	0.675	0.685	0.693
38	Eswatini	0.896	0.874	0.884	0.893	0.896	0.829
39	Ethiopia	0.829	0.829	0.829	0.829	0.829	0.829
40	Fiji	0.949	0.958	0.963	0.956	0.953	0.947
41	Gabon	0.829	0.829	0.829	0.829	0.829	0.829
42	Gambia, The	0.712	0.715	0.722	0.818	0.818	0.820
43	Georgia	0.946	0.947	0.948	0.948	0.947	0.948

SL	Country	14	15	16	17	18	19
44	Ghana	0.703	0.719	0.717	0.783	0.827	0.829
45	Grenada	0.843	0.861	0.867	0.864	0.868	0.870
46	Guatemala	0.915	0.914	0.915	0.915	0.911	0.911
47	Guinea	0.744	0.738	0.750	0.757	0.754	0.766
48	Guinea-Bissau	0.748	0.748	0.751	0.751	0.750	0.754
49	Guyana	0.829	0.833	0.834	0.836	0.833	0.838
50	Haiti	0.678	0.713	0.710	0.710	0.717	0.829
51	Honduras	0.892	0.898	0.899	0.899	0.901	0.903
52	India	0.874	0.881	0.886	0.893	0.895	0.899
53	Indonesia	0.918	0.940	0.940	0.954	0.952	0.952
54	Iran, Islamic Rep	0.989	0.991	0.990	0.987	0.984	0.829
55	Iraq	0.739	0.740	0.743	0.744	0.749	0.748
56	Jamaica	0.962	0.962	0.964	0.957	0.956	0.957
57	Jordan	0.812	0.810	0.823	0.830	0.827	0.828
58	Kazakhstan	0.893	0.892	0.893	0.893	0.894	0.894
59	Kenya	0.832	0.863	0.877	0.871	0.869	0.873
60	Kiribati	0.829	0.829	0.829	0.829	0.829	0.829
61	Kosovo	0.856	0.857	0.859	0.893	0.899	0.829
62	Kyrgyz Republic	0.792	0.824	0.861	0.869	0.885	0.942
63	Lao PDR	0.728	0.729	0.734	0.742	0.745	0.829
64	Lebanon	0.926	0.925	0.923	0.925	0.927	0.927
65	Lesotho	0.732	0.713	0.718	0.729	0.737	0.829
66	Liberia	0.633	0.735	0.712	0.728	0.746	0.754
67	Libya	0.746	0.746	0.746	0.746	0.745	0.829
68	Madagascar	0.739	0.740	0.742	0.748	0.768	0.829
69	Malawi	0.648	0.682	0.745	0.719	0.726	0.720
70	Malaysia	0.942	0.942	0.940	0.939	0.938	0.937
71	Maldives	0.843	0.851	0.859	0.873	0.875	0.875
72	Mali	0.748	0.749	0.750	0.751	0.750	0.752
73	Marshall Islands	0.755	0.755	0.755	0.756	0.756	0.755
74	Mauritius	0.930	0.940	0.935	0.931	0.928	0.927
75	Mexico	0.924	0.926	0.932	0.930	0.936	0.939
76	Micronesia, Fed. Sts	0.767	0.754	0.750	0.747	0.745	0.746
77	Moldova	0.843	0.834	0.842	0.856	0.916	0.926
78	Mongolia	0.926	0.935	0.945	0.941	0.957	0.973
79	Montenegro	0.939	0.939	0.940	0.938	0.939	0.939
80	Morocco	0.847	0.881	0.888	0.892	0.894	0.896
81	Mozambique	0.786	0.805	0.821	0.820	0.824	0.826
82	Myanmar	0.658	0.674	0.704	0.719	0.779	0.863
83	Namibia	0.926	0.932	0.942	0.939	0.942	0.945
84	Nepal	0.831	0.837	0.841	0.849	0.861	0.872
85	Nicaragua	0.792	0.807	0.816	0.823	0.821	0.809
86	Niger	0.674	0.675	0.676	0.737	0.737	0.737

SL	Country	14	15	16	17	18	19
87	Nigeria	0.748	0.747	0.744	0.741	0.741	0.829
88	North Macedonia	0.958	0.959	0.958	0.955	0.954	0.956
89	Oman	0.878	0.877	0.877	0.882	0.879	0.829
90	Pakistan	0.730	0.742	0.753	0.763	0.782	0.788
91	Papua New Guinea	0.761	0.751	0.753	0.757	0.769	0.829
92	Paraguay	0.878	0.868	0.868	0.908	0.921	0.928
93	Peru	0.983	0.977	0.979	0.979	0.981	0.985
94	Philippines	0.901	0.908	0.915	0.919	0.925	0.926
95	Russian Federation	0.892	0.892	0.892	0.892	0.892	0.892
96	Rwanda	0.806	0.806	0.806	0.805	0.818	0.839
97	Samoa	0.883	0.885	0.898	0.902	0.910	0.740
98	Sao Tome and Principe	0.796	0.846	0.840	0.862	0.849	0.829
99	Senegal	0.752	0.754	0.754	0.754	0.754	0.756
100	Serbia	0.920	0.920	0.924	0.920	0.922	0.923
101	Sierra Leone	0.829	0.829	0.829	0.829	0.829	0.829
102	Solomon Islands	0.750	0.746	0.745	0.742	0.829	0.829
103	South Africa	0.992	0.990	0.987	0.987	0.986	0.988
104	South Sudan	0.598	0.599	0.601	0.598	0.597	0.600
105	Sri Lanka	0.929	0.930	0.829	0.829	0.829	0.829
106	St. Lucia	0.869	0.869	0.856	0.867	0.866	0.865
107	St. Vincent	0.843	0.849	0.851	0.853	0.852	0.851
108	Sudan	0.793	0.781	0.736	0.737	0.789	0.829
109	Suriname	0.784	0.944	0.945	0.947	0.946	0.963
110	Syrian Arab Republic	0.829	0.829	0.829	0.829	0.829	0.829
111	Tajikistan	0.770	0.763	0.758	0.760	0.765	0.829
112	Tanzania	0.792	0.660	0.829	0.829	0.829	0.829
113	Thailand	0.968	0.969	0.970	0.970	0.972	0.973
114	Timor-Leste	0.794	0.803	0.803	0.842	0.835	0.859
115	Togo	0.754	0.754	0.756	0.747	0.756	0.756
116	Tonga	0.897	0.856	0.872	0.887	0.876	0.829
117	Tunisia	0.862	0.868	0.873	0.877	0.878	0.875
118	Turkey	0.996	0.997	0.996	0.996	0.996	0.996
119	Uganda	0.648	0.670	0.676	0.684	0.729	0.737
120	Ukraine	0.922	0.921	0.921	0.922	0.922	0.922
121	Uzbekistan	0.754	0.776	0.816	0.842	0.867	0.903
122	Vanuatu	0.839	0.864	0.866	0.870	0.872	0.877
123	Venezuela, RB	0.901	0.904	0.829	0.829	0.829	0.829
124	Vietnam	0.874	0.882	0.890	0.890	0.899	0.903
125	West Bank and Gaza	0.845	0.851	0.859	0.859	0.869	0.879
126	Yemen, Rep	0.709	0.706	0.829	0.829	0.829	0.829
127	Zambia	0.766	0.760	0.758	0.762	0.770	0.762
128	Zimbabwe	0.772	0.780	0.781	0.803	0.874	0.860

Table 11 Financial inclusion index with equal weight and unequal weight

Type of Index	Observations	Mean	Standard deviation	Minimum	Maximum
FII (equal weighted)	3,008	0.852	0.103	0.094	1
FII (weights of Sarma's index)	3,008	0.669	0.209	0.074	1

Appendix C: Comparison of equal weighted index and unequal weighted index

The use of equal weighting is preferable because assigning different weights for different indicators according to economic logic is challenging. Because of missing values in many indicators, assigning different weights affects countries' financial inclusion index scores disproportionately. Due to missing values, the covariance matrix of the principal-component analysis will also be affected.

We construct the unequal-weighted financial inclusion index using weights proposed by Sarma (2012).¹¹

Table 11 shows that both the indices have the same range, but the unequal weighted index has a lower mean and higher standard deviation than the equal-weighted index. We argue that this high dispersion results from assigning different weights in an unbalanced dataset with missing values. The low standard deviation also suggests that the equal-weighted index is better suited to handle missing values.

Table 12 shows the impact of financial inclusion on poverty in developing countries using the two indices. Both indices show a significant impact of financial inclusion on poverty reduction, but the equal-weighted index has higher coefficients than the unequal-weighted index. So, the comparison indicates that the simple equal-weighted index can evaluate financial inclusion adequately.

¹¹ The Sarma (2012) methodology uses three dimensions but multiple indicators in each dimension in constructing the financial inclusion index. We apply the indicators in Table 1 to get the scores for those three dimensions.

Table 12 Poverty-financial inclusion relationship in developing countries using equal-weighted and unequal-weighted financial inclusion index

Time frame: 2004–2019, yearly panel

Variables	System-GMM method		Fixed – effect method	
	FII (unequal weight)	FII (equal weight)	FII (unequal weight)	FII (equal weight)
Dependent variable: log poverty headcount ratio at USD 1.9 per day				
Lag – dependent variable	0.198 (0.122)	0.0305 (0.172)		
Financial inclusion index	– 3.284** (1.235)	– 8.706*** (2.085)	– 1.574*** (0.299)	– 3.780*** (0.927)
GDP growth per capita	– 0.00949 (0.0115)	– 0.0102 (0.00955)	– 0.00748 (0.00492)	– 0.0140*** (0.00525)
Log Gini	2.904*** (0.878)	3.348*** (1.025)	3.416*** (0.659)	3.377*** (0.635)
School enrollment	– 1.549** (0.625)	– 1.286 (0.798)	– 1.217*** (0.302)	– 1.346*** (0.306)
Rule of law	0.355 (0.351)	0.315 (0.256)	– 0.350 (0.286)	– 0.266 (0.300)
Constant	– 0.255 (3.810)	2.263 (4.074)	– 5.046* (2.966)	– 2.182 (3.297)
Observations	275	275	431	431
R – squared			0.428	0.436
<i>Diagnostic tests</i>				
Number of countries	33	33	94	94
Number of instruments	32	32		
AR2 statistics	0.097	0.155		
Hansen J score	0.355	0.418		

Dynamic two-stage system GMM and fixed-effect panel methods. The weights used by Sarma (2012) has been used in constructing the unequal-weighted financial inclusion index. Significance, *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. Robust standard errors are in parentheses

Acknowledgements We acknowledge the two reviewers for their valuable comments and observations.

Funding The authors have no relevant financial or non-financial interests to disclose. The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. The authors have no financial or proprietary interests in any material discussed in this article.

Declarations

Conflict of interest The authors have no conflict of interest to declare that are relevant to the content of this article.

References

- Abor JY, Amidu M, Issahaku H (2018) Mobile telephony, financial inclusion and inclusive growth. *J Afr Bus* 19(3):430453. <https://doi.org/10.1080/15228916.2017.1419332>
- Aker JC, Boumniel R, McClelland A, Tierney N (2014) Payment mechanism and anti-poverty programs: evidence from a mobile money cash transfer experiment in Niger. Tufts University Working Paper. http://sites.tufts.edu/jennyaker/files/2010/02/Zap_-26aug2014.pdf
- Amidžić G, Massara A, Mialou A (2014) Assessing countries' financial inclusion standing—a new composite index. IMF working paper 14/36. <https://www.imf.org/external/pubs/ft/wp/2014/wp1436.pdf>
- Aslan G, Delechat C, Newiak M, Yang F (2017) Inequality in financial inclusion, gender gaps, and income inequality. IMF working paper (2017) wp/17/236. <https://doi.org/10.5089/9781484324905.001>
- Babatz G (2013) Sustained effort, saving billions: lessons from the Mexican government's shift to electronic payments. better than cash alliance evidence paper: Mexico study. <https://responsiblefinanceforum.org/wp-content/uploads/WEB-UNCDF-BTCA-Mexico-Long-Version-English-20150624.pdf>
- Banerjee A, Karlan D, Zinman J (2015) Six Randomized evaluations of microcredit: introduction and further steps. *Am Econ J Appl Econ* 7(1):1–21. <https://doi.org/10.1257/app.20140287>
- Brune L, Gine X, Goldberg J, Yang D (2016) Facilitating savings for agriculture: field experimental evidence from Malawi. *Econ Develop Cultural Chang* 64(2):187–220. <https://doi.org/10.1086/684014>
- Cabeza-García L, Brio EBD, Oscanoa-Victorio ML (2019) Female financial inclusion and its impacts on inclusive economic development. *Women's Stud Int Forum*, 77, ISSN 0277–5395. <https://doi.org/10.1016/j.wsif.2019.102300>
- Cámara N, Tuesta D (2014). Measuring financial inclusion: a multidimensional index. BBVA research working paper 14/26. Madrid, Spain. https://www.bbvaesearch.com/wp-content/uploads/2014/09/WP14-26_Financial-Inclusion2.pdf
- Cole S, Gine X, Vickery J (2013) How does risk management influence production decisions? Evidence from a field experiment. World bank policy research working paper series 6546. <https://openknowledge.worldbank.org/bitstream/handle/10986/15904/WPS6546.pdf?sequence=1&isAllowed=y>
- Demircug-Kunt A, Klapper L, Singer D (2017) Financial inclusion and inclusive growth: a review of recent empirical evidence. Policy research working paper. No. 8040. World Bank. <https://openknowledge.worldbank.org/handle/10986/26479>
- Dupas P, Robinson J (2013) Savings constraints and microenterprise development: evidence from a field experiment in Kenya. *Am Econ J Appl Econ* 5(1):163–192. <https://doi.org/10.1257/app.5.1.163>
- Duvendack M, Palmer-Jones R, Copestake J G, Hooper L, Loke Y, Rao N (2011) What is the evidence of the impact of micro finance on the well-being of poor people? EPPI-Centre, Social Science Research Unit, Institute of Education, University of London. https://purehost.bath.ac.uk/ws/portals/portal/234902/Microfinance_2011Duvendack_report.pdf
- El-Zoghbi M, Holle N, Soursourian M (2019) Emerging evidence on financial inclusion. Consultative group to assist the poorest (CGAP) report. https://www.cgap.org/sites/default/files/publications/2019_07_FocusNote_Emerging_Evidence.pdf
- Gutiérrez-Romero R, Ahamed M (2021) COVID-19 response needs to broaden financial inclusion to curb the rise in poverty. *World Dev* 138:105229. <https://doi.org/10.1016/j.worlddev.2020.105229>
- Honohan P (2008) Cross-country variation in household access to financial services. *J Bank Finance* 32(11):2493–2500. <https://doi.org/10.1016/j.jbankfin.2008.05.004>
- Kara A, Zhou H, Zhou Y (2021) Achieving the United Nations' sustainable development goals through financial inclusion: a systematic literature review of access to finance across the globe. *Int Rev Financial Anal* 77, 101833, ISSN 1057–5219. <https://doi.org/10.1016/j.irfa.2021.101833>
- Karlan D, Osei R, Osei-Akoto I, Udry C (2014) Agricultural decisions after relaxing credit and risk constraints. *Q J Econ* 129(2):597–652. <https://doi.org/10.1093/qje/qju002>
- Kim DW, Yu JS, Hassan MK (2018) Financial inclusion and economic growth in OIC countries. *Research in International Business and Finance*, Elsevier, Vol 43(C), pp 1–14. <https://doi.org/10.1016/j.ribaf.2017.07.178>

- Le TH, Chuc AT, TaghiZadeh-Hesary F (2019) Financial inclusion and its impact on financial efficiency and sustainability: empirical evidence from Asia. *Borsa Istanbul Rev*. <https://doi.org/10.1016/j.bir.2019.07.002>
- Morduch J (1999) The microfinance promise. *J Econ Literat* 37(4):1569–1614. <https://doi.org/10.1257/jel.37.4.1569>
- Muralidharan K, Niehaus P, Sukhtankar S (2014) Payments infrastructure and the performance of public programs: evidence from biometric smartcards in India. National Bureau of Economic Research. NBER Working Paper 1999. https://www.nber.org/system/files/working_papers/w19999/revisions/w19999.rev0.pdf
- Omar MA, Inaba K (2020) Does financial inclusion reduce poverty and income inequality in developing countries? Panel Data Anal Econ Struct 9:37. <https://doi.org/10.1186/s40008-020-00214-4>
- Park CY, Mercado RV (2015) Financial inclusion, poverty, and income inequality in developing Asia. ADB economics working paper series 426/2015. Manila, Philippines. <https://www.adb.org/sites/default/files/publication/153143/ewp-426.pdf>
- Park CY, Mercado R (2018) Financial inclusion, poverty, and income inequality. *Singapore Econ Rev* 63(1):185–206. <https://doi.org/10.1142/S0217590818410059>
- Poverty and Shared Prosperity (2020) Reversals of fortune, World Bank. <https://openknowledge.worldbank.org/bitstream/handle/10986/34496/9781464816024.pdf>
- Prina S (2015) Banking the poor via savings accounts: evidence from a field experiment. *J Develop Econ* 115(C):pp 16–31. <https://doi.org/10.1016/j.jdeveco.2015.01.004>
- Ravallion M, Datt G (1992) Growth and redistribution components of changes in poverty measures: a decomposition with applications to Brazil and India in the 1980s. *J Dev Econ* 38:275–295. [https://doi.org/10.1016/0304-3878\(92\)90001-P](https://doi.org/10.1016/0304-3878(92)90001-P)
- Sandhu N, Hussain J, Matlay H (2012) Barriers to finance experienced by female owner/managers of marginal farms in India. *J Small Bus Enterp Dev* 19(4):640–665. <https://doi.org/10.1108/14626001211277442>
- Sarma M (2012) Index of financial inclusion—a measure of financial sector inclusiveness. Berlin working papers on money, finance, trade and development, 07/2012. https://finance-and-trade.htw-berlin.de/fileadmin/HTW/Forschung/Money_Finance_Trade_Development/working_paper_series/wp_07_2012_Sarma_Index-of-Financial-Inclusion.pdf
- Swamy V (2010) Financial development and inclusive growth: impact of government intervention in prioritized credit *Zagreb international review of economics and business* 13(2):55–72. <https://ideas.repec.org/a/zag/zirebs/v12y2010i2p55-72.html>
- The SDGS in Action: UNDP website. <https://www.undp.org/sustainable-development-goals>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.