

Discussion Paper Series

IZA DP No. 18582

April 2026

Financial Inclusion for Inclusive Growth

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Financial Inclusion for Inclusive Growth¹

Abstract

Using a sample of 67 countries, this article examines how financial inclusion, among other factors, shapes the transition to inclusive and sustainable growth. First, we analyze the heterogeneous and asymmetric relationship between inclusiveness and its main determinants using recent panel quantile regression techniques. Our results suggest that the distributional effects of financial inclusion, institutional quality, and information and communication technology (ICT) diffusion are statistically significant only in the lower tail of the conditional distribution. Although both financial inclusion and ICT diffusion are detrimental to inclusive growth, institutional quality is conducive to greater shared prosperity. Next, we examine the existence of a mediating effect in the process of inclusiveness using non-linear panel threshold modelling. Our results highlight the mediating role of financial inclusion in achieving more inclusive and sustainable growth. While ICT infrastructure negatively impacts growth inclusiveness at low financial inclusion levels, a positive relationship is observed when financial affordability exceeds a certain threshold. Policymakers are called upon to harness the combined impacts of financial inclusion, governance quality, and ICTs to ensure inclusive economic growth.

JEL classification

C23, O11, O16, O43

Keywords

inclusive growth, financial inclusion, non-linear panel data modelling

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¹ This work was sponsored by the Economic Research Forum (ERF) and has benefited from both financial and intellectual support. The views expressed in this work are entirely those of the author(s) and should not be attributed to ERF, its Board of Trustees, or donors.

An updated version is currently being revised for Applied Economics.

1. Introduction

Achieving long-term economic growth and prosperity while ensuring equal opportunities is a major challenge for policymakers. The 2030 Sustainable Development Goals (SDGs) include several elements related to inclusive growth, particularly SDG 8, which seeks to ‘*promote sustained, inclusive, and sustainable growth, full and productive employment, and decent work for all*’ (United Nations 2015).² However, significant disparities in inclusiveness persist across global regions, with developing countries facing nearly double the lack of opportunities compared to developed countries (UNCTAD 2022).³ The inclusive growth process is complex; it involves the interaction of various socioeconomic factors and the heterogeneity of living conditions and inequalities across countries. To formulate strategies for inclusive development, policymakers must be informed by rigorous research examining the drivers of successful growth strategies.

Research on this subject is still in its infancy; various economic factors have been identified as drivers of greater shared prosperity. In a study of ten Asian countries, Pham et al. (2024), employing Chudik et al.’s (2016) cross-sectionally augmented autoregressive distributed lag (CS-ARDL) model, documented the key role of financial systems and effective natural resource management in enhancing inclusiveness. Similarly, Chen et al. (2023) reported that increased access to finance is critical for economic growth in a sample of countries with high financial inclusion levels. Although some studies have identified the financial sector as crucial for promoting inclusiveness, others have argued that greater access to financing can be a barrier beyond a certain threshold. Using a sample of 44 sub-Saharan African (SSA) countries, Amponsah et al. (2021) found that financial inclusion exhibits an inverted U-shaped

² United Nations (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. No. A/RES/70/1. New York.

³ UNCTAD (2022). “In Focus: Inclusive Growth, Stark Contrasts in Inclusive Growth – Progress Towards Equal Opportunities Needed Everywhere.” UNCTAD, Switzerland. Accessed December 1, 2025. <https://sdgpulse.unctad.org/inclusive-growth/>

relationship with inclusive growth; that is, an increase in financial inclusion enhances inclusive growth up to a threshold, after which it declines. Using Baum et al.'s (2003; 2007) two-step efficient generalized method of moments (GMM) estimator, the authors emphasized the moderating role of financial inclusion in the impact of informality on inclusive growth. Additionally, the authors highlighted the role of a robust governance framework in promoting inclusiveness. Arcand et al. (2012) confirmed the existence of a threshold above which higher financial development levels—proxied by private credit as a fraction of GDP—begin to negatively impact economic growth.

Other studies have reported different dynamics of the growth–finance nexus in terms of the existence of a threshold. Using a sample of 42 African countries, Ofori et al. (2023) used Arellano and Bover's (1995) and Blundell and Bond's (1998) system GMM procedure to examine how the interaction between financial development and remittances affects growth inclusiveness. They found a threshold above which the financial sector becomes effective in ensuring equal economic opportunities. Notably, the GMM estimator is the panel data estimator often used to study inclusive growth dynamics. Using data from 27 SSA countries, Oyinlola et al. (2020) investigated the role of governance in the resource mobilization–inclusive growth relationship. They employed Arellano and Bond (1991)'s difference GMM estimator and introduced an interaction term to capture the moderating role of governance in the resource mobilization–inclusive growth relationship.⁴ Similarly, Wang et al. (2023) confirmed the mediating effect of information and communication technology (ICT) in the relationship between financial inclusion and inclusive growth. Focusing on the top ten African countries in terms of ICT infrastructure, the authors used interactive terms in their dynamic

⁴ In a related study, Hathroubi (2019) examined the causal relationships between financial inclusion and standard measures of economic development and economic well-being in Saudi Arabia. Using the GMM methodology, the results demonstrated that financial inclusion is highly and positively correlated with the human development index and share of the employed adult population. Furthermore, considering the presence of threshold effects within a threshold vector error correction model, a non-linear causal relationship was observed among financial inclusion, human development, and economic growth in the long run.

panel data model to assess the combined benefits of ICT and financial inclusion in promoting inclusiveness. The existing literature remains inconclusive on how the inclusive growth process is affected by the various factors identified. Both advanced and developing countries have heterogeneous profiles in terms of shared prosperity, potentially leading to asymmetry or non-linearity in inclusive growth dynamics. The presence of heterogeneous or time-varying relationships tends to be masked when standard linear panel data modelling is used.

Using recent panel data techniques, this study examines how financial inclusion, institutional quality, and ICT infrastructure affect the extent of inclusive growth. Specifically, we assess their complementary effects on enhancing equality and welfare. First, we apply Machado and Silva's (2019) method of moments quantile regression (MMQR) to examine the heterogeneous and distributional impact of financial inclusion, among other factors, on inclusive growth across quantiles. This method is more straightforward to implement in panel data models with fixed effects compared to the computational complexity of other quantile methods (see e.g. Canay 2011; Galvão 2011; Powell 2016). The MMQR estimator is less restrictive as it allows fixed effects to affect all conditional quantiles.⁵ Next, we implement non-linear panel threshold modelling following Kremer et al. (2013) and Seo and Shin (2016). This enables us to assess the presence of a threshold effect in the process of inclusion, while allowing for interactions among the variables. Our study uses a sample of 67 countries over the period 2010–2019, for which data on inclusive growth and its main drivers are available.

The remainder of this article is structured as follows. Section 2 presents the collected data and discusses their properties. Section 3 discusses the various empirical strategies used in this study. Section 4 provides concluding remarks.

⁵ The traditional panel quantile regression estimators require that fixed effects have the same impact in all quantiles (see e.g. Koenker 2004).

2. Data description

As we focus on inclusive growth dynamics, selecting an appropriate measure is crucial for our empirical analysis. Different measures of inclusiveness have been proposed in the empirical literature. Using a sample of 37 SSA economies, Adejumo et al. (2020) investigated the role of technological development and innovation in enhancing inclusive growth. They considered three inclusive growth measures: income growth per capita, inequality-adjusted human development index (IHDI), and unemployment. Using IHDI as a dependent variable may introduce redundancy or overlap with explanatory variables such as education and income metrics. In a recent study, Jinapor et al. (2025) used the Asian Development Bank framework to evaluate inclusive growth in 32 SSA countries. They used principal component analysis (PCA) to create a composite index from 18 variables encompassing various aspects of inclusiveness, such as economic growth, inequality, access to education and healthcare, energy consumption, and governance. We prefer not to use a composite index of inclusive growth as the dependent variable because our empirical specification uses PCA-based indices for our key explanatory variables—financial inclusion, ICT infrastructure, and governance quality. Other empirical studies have followed the approach of Anand et al. (2013), who proposed using the concept of social mobility function to measure inclusive growth (see Badmus et al. 2024; Epo et al. 2025).

Table 1. Descriptive statistics

	Mean	SD	Min.	Q₁ (.25)	Median	Q₃ (.75)	Max.
Real GDP per person	11,163.62	13,895.50	442.17	2,575.40	5,054.53	12,980.62	65,129.38
Trade openness (% of GDP)	91.39	52.77	24.70	57.76	82.33	107.83	379.10
Domestic investment (% of GDP)	24.89	8.23	8.93	19.96	23.18	27.41	69.48
Government expenditure (% of GDP)	15.71	4.68	4.81	12.30	15.47	19.26	30.00
Population (annual %)	1.17	1.37	-2.08	0.19	1.19	1.84	11.48
Unemployment (% of total labour force)	7.95	6.41	0.10	3.64	5.57	10.14	32.02

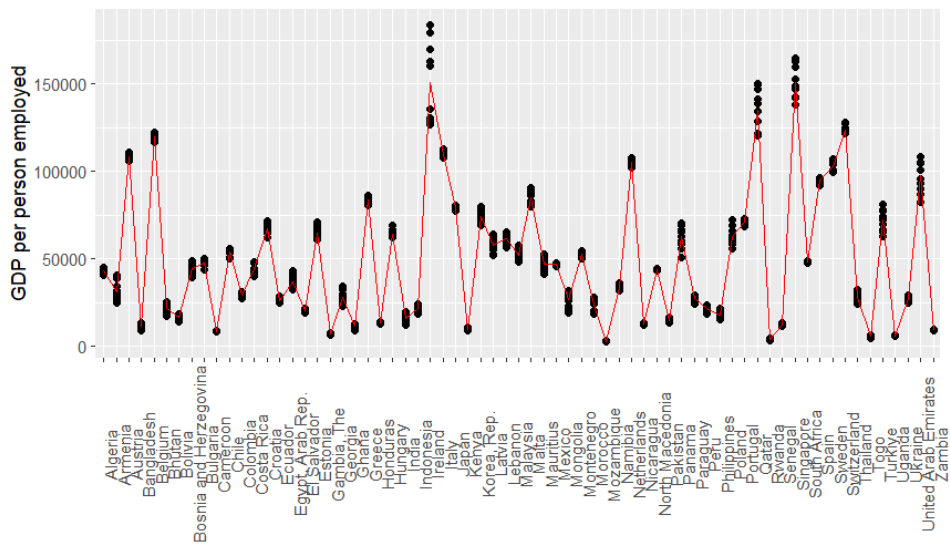
Financial inclusion indicators							
<i>ATMs</i>	52.21	44.17	0.77	21.61	49.68	67.81	288.59
<i>Bank branches</i>	18.47	15.30	0.41	8.30	14.14	23.60	95.93
<i>Bank accounts</i>	1453.29	1244.94	54.12	632.39	1109.13	1925.91	7270.62
<i>Deposits (% of GDP)</i>	60.38	40.73	11.13	35.08	46.98	74.03	251.26
<i>Loans (% of GDP)</i>	56.31	34.23	5.95	31.13	48.92	76.5691787	167.85
PCA-based financial index	0.05	1.69	-2.58	-1.37	-0.13	1.02	4.67
Governance indicators							
<i>Government effectiveness</i>	0.13	0.76	-1.33	-0.47	0.07	0.62	2.32
<i>Control of corruption</i>	-0.04	0.82	-1.34	-0.64	-0.25	0.46	2.17
<i>Political stability</i>	-0.13	0.82	-2.81	-0.68	-0.10	0.55	1.62
<i>Regulatory quality</i>	0.20	0.73	-1.37	-0.30	0.10	0.68	2.26
<i>Rule of law</i>	0.01	0.78	-1.49	-0.57	-0.14	0.51	1.97
<i>Voice and accountability</i>	0.01	0.76	-1.91	-0.56	-0.02	0.58	1.61
PCA-based governance index	0.04	2.21	-3.75	-1.68	-0.44	1.61	4.98
ICT infrastructure							
<i>Fixed telephone subscriptions</i>	18.98	16.06	0.09	5.18	15.46	30.13	62.85
<i>Individuals using the Internet</i>	50.14	27.38	3.00	25.00	52.41	73.43	99.65
<i>Mobile cellular subscriptions</i>	111.94	30.42	30.70	94.24	112.87	131.12	212.64
PCA-based ICT index	-0.02	1.49	-3.14	-1.13	0.05	1.25	2.94

Notes: Data were collected from 67 countries for the annual period 2010–2019. SD, min., max., Q1 (.25), and Q3 (.75) represent the standard deviation, minimum, maximum, first quartile, and third quartile, respectively.

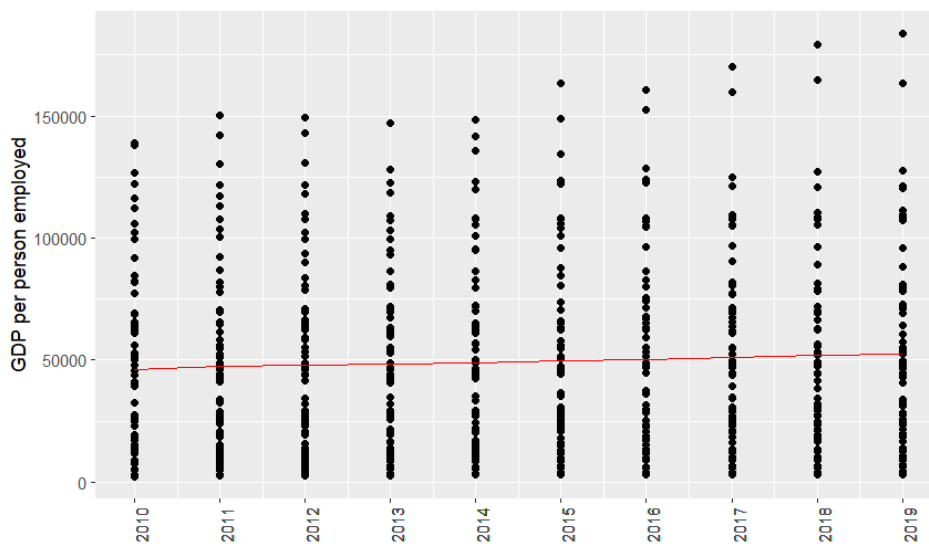
Additionally, the logarithm of real GDP per person employed in a country has been used as a proxy for inclusive growth (see e.g. Amponsah et al. 2021; Assfaw et al. 2025; Oyinlola and Adedeji 2019; Oyinlola et al. 2020; Raheem et al. 2018, among others). This measure allows us to capture a country’s ability to create and achieve fair and equitable opportunities for the population. It’s true that GDP per person employed is a narrow indicator that doesn’t capture all aspects of inclusiveness, such as inequality and access to services. However, it is a practical proxy because it focuses on the economic and employment aspects of inclusivity while avoiding redundancy or overlapping issues with the explanatory variables. In our empirical specification, we chose to use GDP per person employed (Δy_{it}) as an

alternative measure of inclusive growth, reflecting the opportunities available to the population and their distribution. Data on inclusive growth were collected from 67 countries for the period 2010–2019. Table A2 in the Appendix presents the full list of the 67 countries selected for our study. Figure 1 shows the measure of GDP per person employed across countries and over time, indicating a high degree of heterogeneity in the panel data.

Figure 1. The heterogeneity of inclusiveness in the panel data



(a) Heterogeneity across countries



(b) Heterogeneity across time periods

Notes: The plots represent the average GDP per person employed in our panel of 67 countries over the annual period 2010–2019.

Several financial inclusion measures have been used in the literature.⁶ The existing literature suggests that financial inclusion measures should consider multiple aspects and cannot be captured by a single indicator. Mainly, three basic dimensions should be considered: accessibility criteria (banking penetration), availability of banking services, and banking services usage (see e.g. Sarma 2008; Sarma and Pais 2011).⁷ The most used indicators in the empirical literature include the number of bank branches (per capita), number of ATMs, number of bank accounts, and number of credit cards (see e.g. Abdul Karim et al. 2022; Emara and El Said 2021). In our study, we consider different measures of financial inclusion: (1) ATMs per 100,000 adults; (2) bank branches per 100,000 adults; (3) bank accounts per 1,000 adults; (4) outstanding deposits from commercial banks (% of GDP); and (5) outstanding loans from commercial banks (% of GDP). Financial inclusion data were obtained from the International Monetary Fund's (IMF) Financial Access Survey.

We selected a set of independent macroeconomic variables that may influence inclusive growth dynamics: domestic investment; government expenditure; population growth rate; unemployment rate; and trade openness. Additionally, as institutional quality influences inclusive growth strategies, we follow Amponsah et al. (2021) and consider six governance dimensions: (1) corruption control; (2) government effectiveness; (3) political stability; (4) regulatory quality; (5) rule of law; and (6) voice and accountability.⁸ For ICT investments, three measures are used: fixed telephone subscriptions (per 100 people); mobile cellular subscriptions (per 100 people); and individuals using the Internet (% of the population). Governance indicators were sourced from the World Governance Indicators (WGI) database

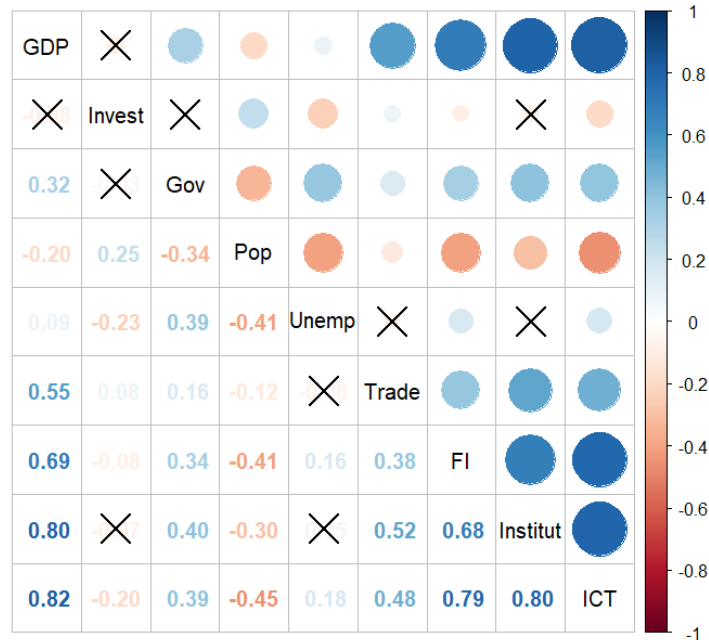
⁶ Amponsah et al. (2021) computed a financial inclusion measure using data from the IMF's Financial Access Survey (IMF 2020), following Sarma (2008). The computed index measure ranges from zero to one, in which zero corresponds to no financial inclusion and one indicates greater financial inclusion.

⁷ Other dimensions have been used in the literature, such as ease of transactions, cost of transactions, and barriers to credit (see e.g. Cao and Zhang 2020).

⁸ Using a sample of 44 emerging and Middle East and North African (MENA) countries, Emara and El Said (2021) examined the impact of governance quality on the financial inclusion–growth nexus, in which the governance indicator index is computed using the PCA of six main dimensions.

of the World Bank. ICT and macroeconomic variables were sourced from the World Development Indicators (WDI) of the World Bank.

Figure 2. Correlation matrix of key variables



The correlogram above reports the correlations among the key variables over the annual period 2010–2019. X indicates non-significant correlation coefficients.

Composite indices were constructed using PCA as a proxy for financial inclusion, governance quality, and ICT infrastructure. PCA is a useful tool for data reduction because it enables the extraction of valuable information from large datasets. The principal components are orthogonal, with earlier components retaining most information. The eigenvalues of each principal component are listed in Table 2.⁹ The first component of the financial inclusion variable has an eigenvalue of 2.8 (higher than one), explaining 56.2% of the total variance. However, the second principal component shows a smaller variance (0.92) that is less than the cut-off of 1, representing only 18.4% of the total variation. The first principal component is the best representation of our financial inclusion dataset. The same applies to the governance and ICT data, in which the first principal component retains more than 70% of the total variance.

⁹ Eigenvalues measure the amount of variance each principal component retains.

Figure A1 in the Appendix shows the contribution of each variable to the first component. For the financial inclusion variables, the ratio of outstanding bank loans and number of bank accounts are the most significant contributors to the first principal component. Each variable contributed more than 20% to the first component, which is the expected average contribution (see the red dashed line in Figure A1).¹⁰

Table 2. Eigenvalues and proportion of variances using PCA

Component	Eigenvalue	% of variance	Cumulative % of variance
Financial inclusion index			
1	2.811	56.220	56.220
2	0.923	18.465	74.686
3	0.715	14.315	89.001
4	0.348	6.973	95.975
5	0.201	4.024	100.000
Governance quality index			
1	4.945	82.426	82.426
2	0.442	7.381	89.808
3	0.375	6.254	96.062
4	0.137	2.289	98.352
5	0.057	0.950	99.302
6	0.041	0.697	100.000
ICT index			
1	2.178	72.608	72.608
2	0.600	20.008	92.616
3	0.221	7.383	100.000

Notes: Eigenvalues measure the amount of variation retained by each principal component. The percentage of variation explained by each eigenvalue is presented in the second column. For example, 2.81 divided by 5 equals 56.22% of the variation explained by the first eigenvalue. The cumulative percentage explained was obtained by adding successive proportions of the variation explained to obtain the running total.

All variables are transformed into natural logarithms, except for the composite indices and variables of growth rates and shares. Table 1 presents the summary statistics for the key

¹⁰ We examined the relevance of our data for PCA using Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. The results are not reported for brevity but can be provided upon request.

variables. Full details of the definitions and sources of the data are reported in Table A1 in the Appendix. Figure 2 displays the correlation matrix that traces the co-movement among the key variables. The inclusive growth measure is strongly and positively correlated with financial inclusion, ICT, and institutional quality. Notably, domestic investment is not significantly correlated with the inclusiveness and governance measures and is negatively linked to financial access and ICT indices. The negative effect of domestic investment is plausible if increased domestic capital accumulation leads to inequitable resource allocation. Nevertheless, the results of the correlation analysis should be interpreted with caution. Our panel data show a high degree of heterogeneity, which should be modelled in a non-linear framework.¹¹

3. Empirical strategy and main results

3.1. Results from the linear dynamic panel data

As discussed in the previous section, the relationship between inclusive growth and access to finance is country-specific and time-varying. Differences in the time period and sample of countries considered would yield different outcomes. We begin by estimating the following linear dynamic panel data model over different time periods and subsamples of countries.

$$\Delta y_{it} = \alpha_i + \lambda \Delta y_{it-1} + \beta' X_{it} + \varepsilon_{it}, \quad (1)$$

where i represents the cross-sections and t is the time period. α_i denotes cross-section fixed effects. X_{it} is a vector of explanatory variables that may influence inclusive growth Δy_{it} , including factors such as financial inclusion and governance quality, among others. The linear panel data model is estimated over three different time periods: 2010–2019, 2010–2014, and 2014–2019. The estimation is also conducted for a group of 20 high-income countries versus

¹¹ Finally, we test for the presence of a unit root in the selected data series. We apply the panel unit root test developed by Karavias and Tzavalis (2014), which allows for one or two structural breaks in the deterministic components. Additionally, the procedure allows for cross-section dependence and heteroscedasticity. The results of the panel unit root tests confirm the stationarity of our variables. The results are not reported for brevity but are available upon request.

a group of 47 emerging markets and developing economies (EMDEs). Eq. (1) is estimated using Arellano and Bover's (1995) and Blundell and Bond's (1998) system GMM method. The two standard diagnostic tests for assessing the reliability of the GMM estimator—the serial correlation test and Hansen's (1982) *J*-test of overidentification restriction—were performed. As reported in Table 3, *p*-values in square brackets indicate that neither the null of no autocorrelation nor the null of valid overidentification conditions could be rejected at the 5% significance level.

The system GMM estimates provided in Table 3 indicate that the impact of the main macroeconomic variables—domestic investment, government expenditure, and trade openness—is consistent across the different time periods and country groups; that is, high-income countries versus EMDEs. The unemployment rate is an exception, in which the impact on growth inclusiveness is negative and statistically significant only for the 47 EMDEs and for the period 2015–2019. Financial inclusion and institutional quality have a time-varying relationship with inclusive growth that varies across the country groups. Better governance quality increases inclusiveness over the 2015–2019 period and in high-income countries. Surprisingly, improved access to finance is detrimental to inclusive growth in the sample of 47 emerging and developing countries. The affordability of financial services does not significantly impact the panel of the 20 advanced economies. Notably, ICT penetration has a negligible effect on the degree of growth inclusiveness. We found a negative effect for the group of emerging and developing countries, which is statistically significant at the 10% level.

We also examined the drivers of inclusive growth in different geographical regions: Latin America and the Caribbean (LAC), the Middle East and North Africa (MENA), and SSA. Our panel dataset includes 12 countries from LAC, 7 from MENA, and 13 from SSA.¹² Table

¹² Our sample of seven MENA countries includes Qatar and the UAE, even though they are classified as high-income countries by the World Bank.

3 shows that the impacts of financial inclusion, institutional quality, and ICT diffusion vary across the country groups. Financial access increases the inclusiveness of LAC countries at the 10% significance level. However, the opposite relationship is found for the SSA region, in which financial inclusion reduces inclusive growth by 0.02% at the 1% significance level. This relationship is not statistically significant for MENA countries. This result could be attributed to our panel dataset having only seven MENA countries.

Previous studies have demonstrated the importance of financial inclusion in the MENA region. Using the GMM estimator, Neaime and Gaysset (2018) confirmed the key role played by the affordability of banking services in reducing income inequality and poverty. For a panel of 8 MENA countries, the authors used the number of commercial banks per 100,000 adults as a proxy for financial inclusion, which negatively affects the Gini index, serving as a proxy for income inequality. Furthermore, using disaggregated sectoral data, Cama and Emara (2022) underscored the beneficial role of widening financial coverage in manufacturing industries depending on their R&D intensity. The authors revealed that financial inclusion enhances gross capital formation levels, particularly for low-R&D industries in the MENA region. Additionally, the positive role of institutional quality is confirmed for both the MENA and SSA regions. However, ICT infrastructure positively impacts inclusive development only in LAC countries.

Table 3. Results from the linear dynamic panel data models

	Dependent variable: Inclusive growth							
	2010–2019	2010–2014	2015–2019	High income	EMDE	LAC	MENA	SSA
Lagged inclusive growth	0.292*** (0.0192)	0.0360 (0.0564)	0.0735 (0.0852)	0.4170*** (0.0453)	0.1578*** (0.0360)	0.2962*** (0.0462)	0.0757 (0.0641)	0.1465*** (0.0340)
Domestic investment	0.0016*** (0.0006)	0.0018*** (0.0004)	0.0010*** (0.0004)	0.0016*** (0.0002)	0.0006*** (0.0001)	0.0040*** (0.0016)	0.0027*** (0.0012)	0.0021*** (0.0005)
Government expenditure	-0.0187*** (0.0004)	-0.0028** (0.0011)	-0.0094*** (0.0015)	-0.0187*** (0.0015)	-0.0169*** (0.0009)	-0.0498* (0.0283)	-0.0056** (0.0027)	0.0008 (0.0015)
Population	-0.0078* (0.0040)	-0.0063* (0.0038)	-0.0121** (0.0056)	-0.0078*** (0.0018)	-0.0055** (0.0026)	-0.2341* (0.1477)	-0.0096*** (0.0019)	-0.0221*** (0.0035)
Unemployment	-0.0021 (0.0029)	-0.0012 (0.0014)	-0.0022** (0.0011)	-0.0021* (0.0012)	-0.0044*** (0.0009)	0.0826 (0.0503)	0.0112*** (0.0042)	-0.0007 (0.0018)
Trade openness	0.0012*** (0.0003)	0.0004** (0.0002)	0.0007*** (0.0003)	0.0012*** (0.0001)	0.0015*** (0.0001)	0.0060* (0.0036)	0.0009 (0.0012)	0.0005*** (0.0001)
Financial inclusion	-0.0095*** (0.0019)	0.0098 (0.0066)	-0.0156*** (0.0033)	0.0102 (0.0073)	-0.0034*** (0.0015)	0.4335* (0.2663)	-0.0048 (0.0102)	-0.0199*** (0.0049)
Governance	0.0200*** (0.0025)	0.0098 (0.0066)	0.0156*** (0.0036)	0.0336*** (0.0045)	0.0013 (0.0024)	0.0444 (0.0299)	0.0388*** (0.0136)	0.0349*** (0.0072)
ICT	-0.0028 (0.0245)	0.0130 (0.0104)	-0.0042 (0.0037)	-0.0126 (0.0082)	-0.0031* (0.0278)	0.0595** (0.0315)	0.0110 (0.0157)	-0.0001 (0.0023)
Observations	670	335	335	210	460	120	70	130
AR(2) test	1.402 [0.160]	1.227 [0.219]	1.481 [0.138]	1.303 [0.192]	0.625 [0.531]	0.725 [0.468]	1.134 [0.256]	1.376 [0.168]
J-test	46.774 [0.152]	36.545 [0.134]	24.257 [0.094]	31.177 [0.104]	41.708 [0.134]	29.481 [0.338]	24.726 [0.589]	33.426 [0.167]

Note: The results were obtained from the linear dynamic panel data model shown in Eq. (6). The AR(2) test has the null hypothesis of no second-order serial correlation in the first-differenced residuals, whereas the J-test has the null of valid overidentifying moment conditions; p-values are reported in square brackets.

Overall, the results in Table 3 confirm the heterogeneity of the inclusion process, which appears to be time-varying and country-specific. In their study on the dynamics of financial inclusion in MENA countries, Damra et al. (2023) highlighted the specificity of access to financial products and services in the region. The authors documented a non-linear mechanism that takes the form of an inverted U-shaped curve between financial inclusion and trust in banks. Shen et al. (2024) investigated the possible asymmetric relationship between financial inclusion and economic growth for the top ten financially inclusive MENA economies. Using Sim and Zhou's (2015) quantile-on-quantile method, they highlighted that expanding financial access boosts growth in almost all conditional quantiles, although there is considerable heterogeneity across MENA countries. Given the complexity of economic development strategies, our study suggests using recent panel data techniques to address possible heterogeneity and non-linearity in growth inclusiveness.

3.2. Results from the panel quantile regression models

The linear dynamic panel data analysis confirms the heterogeneous relationship between inclusive growth and its main determinants, particularly financial inclusion and institutional quality. Next, we apply the MMQR procedure to estimate the heterogeneous effects across the conditional distribution of growth inclusiveness. The location-scale panel data model from which we estimate the conditional quantiles $Q_Y(\tau|X_{it})$ of a response variable Y_{it} , whose distribution conditional on a k -vector of explanatory variables X_{it} , takes the following form.

$$\Delta y_{it} = \mu_i + X'_{it}\beta + (v_i + Z'_{it}\gamma)U_{it}, \quad (2)$$

where $i = 1, \dots, 67$, $t = 1, \dots, 10$. In our empirical analysis, Δy_{it} represents the measure of inclusive growth. X_{it} is a vector of k explanatory variables, including the lagged dependent variable Δy_{it-1} . μ_i and v_i are country-specific fixed effects. Z_{it} is a known differentiable transformation of X_{it} with l components and is expressed as follows.

$$Z_{it}^l = z_l(X_{it}), \text{ where } l = 1, \dots, k. \quad (3)$$

where $\Pr\{\mu_i + \nu_i Z_{it}' \gamma > 0\} = 1$. U_{it} is an i.i.d. variable normalized to satisfy the moment conditions $E(U) = 0$; $E(|U|) = 1$. Eq. (2) can be formulated as follows.

$$Q_Y(\tau|X) = (\mu_i + \nu_i q(\tau)) + X_{it}' \beta + \nu_i + Z_{it}' \gamma q(\tau), \quad (4)$$

Eq. (4) is estimated using Machado and Silva's (2019) MMQR estimator. Within this framework, the distributional fixed effect at the τ -th quantile has the following expression: $\mu_i(\tau) \equiv \mu_i + \nu_i q(\tau)$. In the standard panel quantile regression model, fixed effects are assumed to be pure location shifts with the same impact across all quantiles (see e.g. Canay 2011; Koenker 2004). The MMQR procedure allows the quantile fixed effect to have different impacts on the conditional distribution of the response variable. It is worth noting that the MMQR procedure requires large time-series observations (T) to produce reliable inference. Given the relatively short time dimension of our panel data ($T = 10$), we examined the robustness of the results. We use the quantile regression estimator for panel data (QRPD) with the non-additive fixed effects in Powell (2022), which yields consistent estimates when T is small. Additionally, biases related to potentially endogenous explanatory variables can be addressed using the QRPD estimator.

Table 4 displays the results of the different panel quantile regression procedures. The heterogeneous effect of inclusive growth drivers is assessed through five quantiles—10th, 25th, 50th, 75th, and 90th—of the conditional distribution of inclusive growth. Figure 4 shows a visual representation of the point estimates (with 95% confidence bands) across the range of conditional quantiles. The MMQR estimates indicate that the marginal effect of financial

inclusion on growth inclusiveness is statistically significant, yet negative, only at the lower tail of the condition distribution, $\tau = 0.10$ and $\tau = 0.25$. Greater access to financial services is detrimental for countries with low growth inclusiveness levels but is not significant for countries with greater shared prosperity. This outcome is confirmed using Powell's (2022) QRPD estimator.

Table 4. Results from the panel quantile regression models

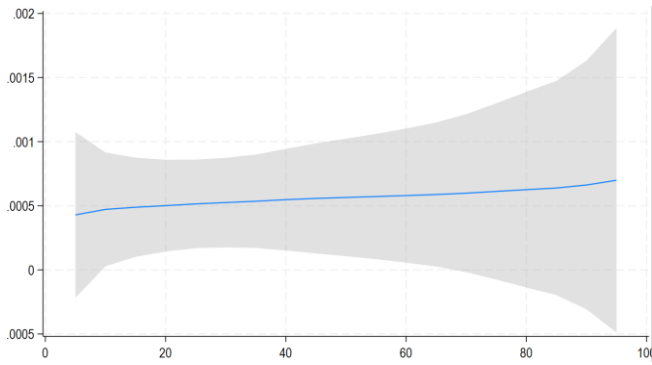
	Dependent variable: Inclusive growth				
	$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.50$	$\tau = 0.75$	$\tau = 0.90$
	MMQR of Machado and Silva (2019)				
Lagged inclusive growth	0.2762*** (0.0622)	0.2681*** (0.0484)	0.258*** (0.0643)	0.2496*** (0.0964)	.2401* (0.1360)
Domestic investment	0.0004** (0.0002)	0.0005*** (0.0001)	0.0005** (0.0002)	0.0006* (0.0003)	0.0006 (0.0004)
Government expenditure	-0.0014*** (0.0004)	-0.0014*** (0.0003)	-0.0013*** (0.0004)	-0.0013* (0.0007)	-0.0013063 (0.0010)
Population	-0.004*** (0.0013)	-0.0050*** (0.0010)	-0.0057*** (0.0013)	-0.0063*** (0.0020)	-0.0070** (0.0028)
Unemployment	-0.0022** (0.0009)	-0.0017** (0.0006)	-0.0013** (0.0005)	-0.0008 (0.0006)	-0.0004 (0.0007)
Trade openness	-0.0008** (0.0004)	-0.0005* (0.0003)	-0.0002 (0.0004)	0.0001 (0.0006)	0.0004 (0.0008)
Financial inclusion	-0.0024** (0.0012)	-0.0025*** (0.0009)	-0.0027** (0.0012)	-0.0029 (0.0018)	-0.0031 (0.0026)
Governance	0.0030*** (0.0011)	0.0018** (0.0008)	0.0005 (0.0011)	-0.0007 (0.0016)	-0.0020 (0.0023)
ICT	-0.0077*** (0.0026)	-0.0069*** (0.0018)	-0.0062** (0.0024)	-0.0055 (0.0038)	-0.0047 (0.0054)
	QRPD of Powell (2022)				
Lagged inclusive growth	0.3139*** (0.058)	0.2387*** (0.0505)	0.2793*** (0.0607)	0.2171*** (0.0621)	0.1947*** (0.0423)
Domestic investment	0.0005***	0.0004**	0.0007***	0.0005*	0.0007*

	(0.0001)	(0.0001)	(0.0001)	(0.0003)	(0.0004)
Government expenditure	-0.0011***	-0.0009***	-0.0011***	-0.0016***	-0.0016*
	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0010)
Population	-0.0065***	-0.0084***	-0.0087***	-0.0093***	-0.0093***
	(0.0008)	(0.000)	(0.0008)	(0.0009)	(0.0015)
Unemployment	-0.0002	-0.0006***	-0.0004**	-0.0002	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Trade openness	-0.0002*	-0.0002	0.0003	0.0007	0.0003
	(0.0001)	(0.0002)	(0.0002)	(0.0004)	(0.0003)
Financial inclusion	-0.0027**	-0.0017***	-0.0008	-0.0017	-0.0024
	(0.0011)	(0.0004)	(0.0009)	(0.0011)	(0.0023)
Governance	0.0057***	0.0024***	.0012382	0.0017*	-0.0007
	(0.0014)	(0.0009)	(0.0010)	(0.0009)	(0.0012)
ICT	-0.0085***	-0.0056***	-0.0070***	-0.0083	-0.0070
	(0.0024)	(0.0021)	(0.0017)	(0.0058)	(0.0052)

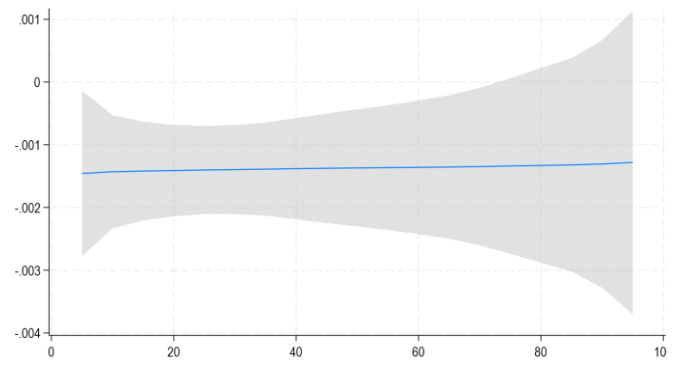
Note: Standard errors are reported in brackets, except for MMQR, in which clustered standard errors are reported. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

Similarly, ICT diffusion negatively affects the adoption of inclusive growth strategies, having negative effects in lower quantiles and also in the middle of the conditional distribution ($\tau = 0.50$). Governance quality plays a beneficial role, with significant positive effects in the lower quantiles of inclusiveness distribution. Governance factors, including the quality of policy formulation and implementation, play crucial roles in promoting inclusiveness in countries with low equal opportunities. The remaining macroeconomic variables have the expected signs across the conditional quantiles, as in the linear dynamic panel data specification, except for the upper tail of the distribution in which most are insignificant. Given the unexpected negative signs of financial inclusion and ICT in the relationship with growth inclusiveness, we suggest using a different non-linear panel data framework to test the possible moderating role of these variables.

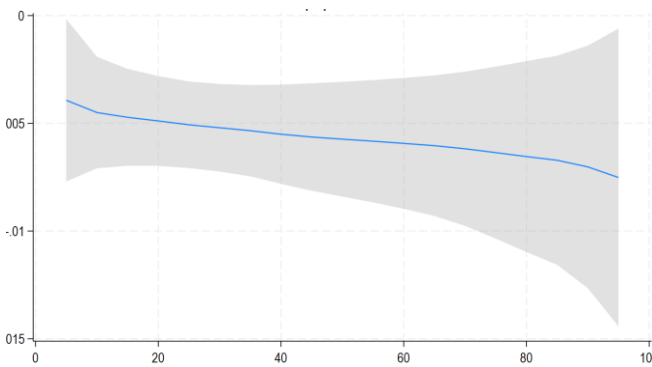
Figure 3. Plots of the coefficients for the different quantiles



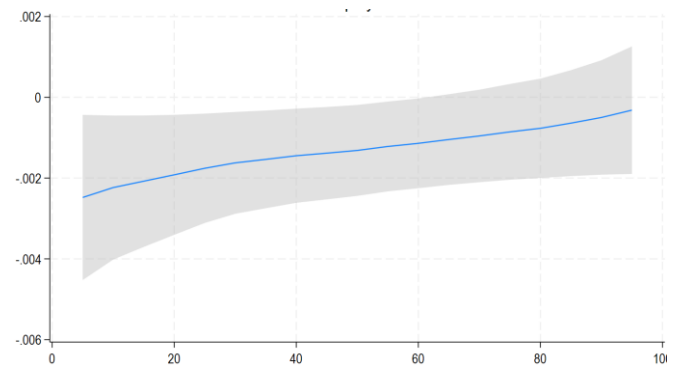
(a) Domestic investment



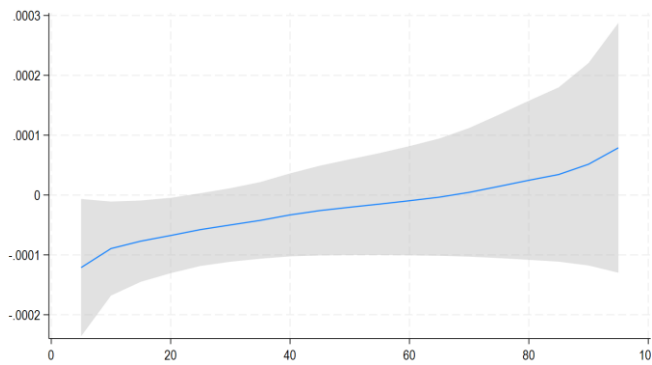
(b) Government expenditure



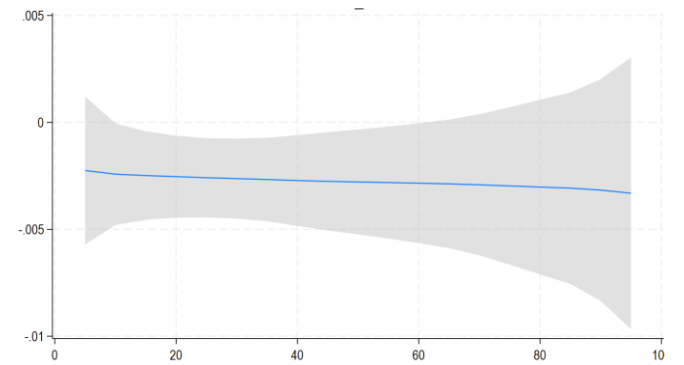
(c) Population



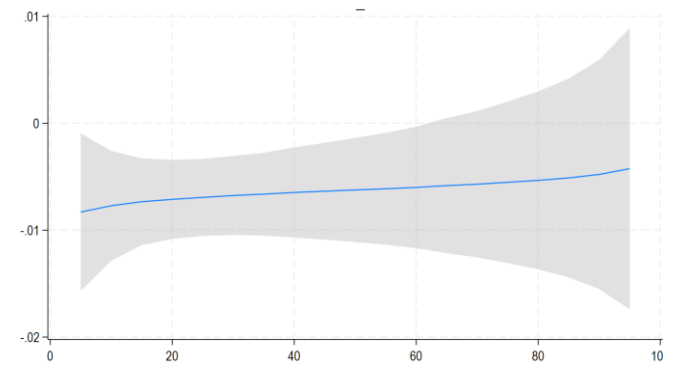
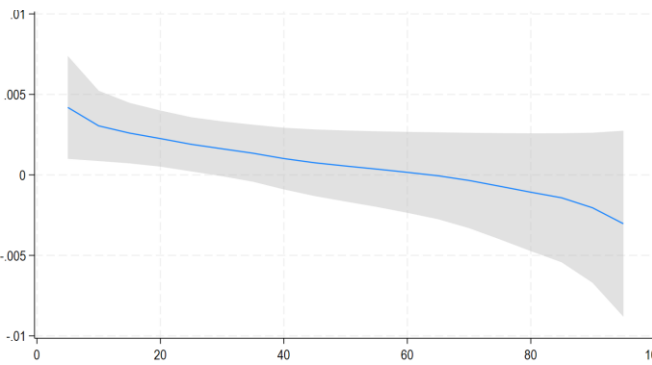
(d) Unemployment



(e) Trade openness



(f) Financial inclusion



Note: The x-axis indicates the range of conditional quantiles of inclusive growth and the y-axis indicates the distributional effect of each explanatory variable.

3.3. Results from the dynamic threshold panel data model

As observed above, it is surprising that financial inclusion and ICT diffusion are detrimental to inclusiveness, which is counterintuitive. As a final step, we propose to examine this puzzle by investigating the possible existence of threshold effects in the transition to inclusive and sustainable growth. A possible alternative is to experiment with a non-linear panel threshold regression model, in line with Kremer et al. (2013) and Seo and Shin (2016), in which the interaction between the variables is allowed. A non-linear panel data model with a single threshold (two regimes) is expressed as follows.

$$\Delta y_{it} = (1, X'_{it})\beta_1 I\{q_{it} \leq \gamma\} \mu_i + (1, X'_{it})\beta_2 I\{q_{it} > \gamma\} + \varepsilon_{it}, \quad (5)$$

where $I(\cdot)$ is the indicator function, q_{it} is the threshold variable, and γ is the threshold parameter that divides the equation into two regimes with coefficients β_1 and β_2 . X_{it} is a vector of the time-varying explanatory variables that may influence inclusive growth y_{it} , including factors such as financial inclusion and governance quality, among others. As discussed in Seo and Shin (2016), X_{it} may include the lagged dependent variable.

In our implementation of the threshold panel method, we consider different moderating variables that would influence inclusive growth dynamics, which can directly interact with our key explanatory variables, namely financial inclusion (FI_{it}), governance quality (GOV_{it}), and ICT infrastructure (ICT_{it}): $q_{it} = (FIN_{it}; GOV_{it}, ICT_{it})$. If the threshold variable q_{it} is below or above a certain value γ , then the financial inclusion index would have different impacts on inclusive growth, represented by $\beta_1 \neq \beta_2$. Following Seo and Shin (2016), we implement the first-difference generalized method of moments (FD-GMM) approach, which allows both the threshold variables and regressors to be endogenous.

Table 5. Results from the dynamic panel threshold models

	Dependent variable: Inclusive growth		
	(1)	(2)	(3)
Threshold variables (q_{it})	FI_{it}	GOV_{it}	ICT_{it}
Threshold value ($\hat{\gamma}$)	0.5931*** (0.1538)	0.8045*** (0.1033)	0.1482*** (0.0228)
Lagged inclusive growth	0.1954*** (0.0538)	0.3679** (0.1548)	0.2442*** (0.0229)
Domestic investment	0.0021*** (0.0003)	0.0018*** (0.0003)	0.0017**** (0.0003)
Government expenditure	-0.0113*** (0.0009)	-0.0110*** (0.0009)	-0.0106*** (0.0009)
Population	-0.0054** (0.0022)	-0.0048** (0.0022)	-0.0044** (0.0022)
Unemployment	0.0010 (0.0007)	0.0005 (0.0007)	0.0004 (0.0007)
Trade openness	0.0010*** (0.00013)	0.0010*** (0.0001)	0.0009*** (0.0001)
Lower regime			
Financial inclusion		-0.0037 (0.0028)	0.0141*** (0.0050)
Governance	0.0040 (0.0036)		-0.0268 (0.0210)
ICT	-0.0202*** (0.0062)	-0.0123** (0.0049)	
Upper regime			
Financial inclusion		0.0512*** .0140273	0.0640*** (0.0146)
Governance	0.0164** (0.0069)		0.0288*** (0.0049)
ICT	0.0329*** (0.0085)	0.2712*** (0.0694)	

Observations	670	670	670
Linearity (p -value)	0.000	0.000	0.000
J -test	23.463	18.434	21.253
	[0.243]	[0.183]	[0.211]

Note: The estimation results were obtained from the dynamic panel threshold model, as specified in Eq. (9), for the period 2010–2019. For the linearity test, the bootstrap p -values of the supW test are reported, in addition to the J -test examining the validity of the overidentifying moment conditions; p -values are in square brackets. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

The results of the different panel threshold specifications are displayed in Table 5.¹³ When considering financial inclusion as a threshold variable, we note that the effect of institutional quality is not significant in the lower regime; that is, $FI_{it} \leq 0.6$. However, when financial access exceeds the estimated threshold $\hat{\gamma} = 0.6$, the governance framework significantly and positively impacts inclusive growth. The impact of ICT penetration on the extent of inclusiveness is asymmetric with respect to financial affordability level. Point estimates indicate a statistically significant negative impact in the low financial inclusion regime. However, ICT positively and significantly impacts the adoption of more inclusive growth at higher financial access levels. As Figure 4 shows, there is significant disparity in access to financing across regions. High-income countries have higher financial coverage, whereas financial inclusion levels in the SSA region lag below the estimated threshold. Our empirical results emphasize that greater inclusive growth can be effectively ensured by better governance and ICTs, provided that financial access is higher. Successful inclusive growth strategies in developing countries hinge on improving access to credit and banking services.

Institutional quality as a threshold variable also confirms the asymmetric relationship between ICT and growth inclusiveness. When governance quality is below the threshold of $\hat{\gamma} = 0.8$, point estimates indicate a negative impact of ICTs. However, with better-quality institutions, that is, $GOV_{it} > 0.8$, the relationship between ICT penetration and inclusiveness

¹³ As we focus on the mediating effects of financial inclusion, institutional quality, and ICT, we do not report the coefficients of the other variables in the upper regimes for brevity.

becomes significantly positive. The moderating role of institutional quality on financial inclusion is also confirmed. Although the impact of access to financing is not statistically significant under lower governance quality, a significant positive relationship is observed under a robust governance framework. Finally, the ICT composite index, introduced as a threshold variable, plays a moderating role in the process of inclusive growth. Particularly, the relationship between institutional quality and inclusiveness changes depending on ICT infrastructure development. The impact of governance quality is not statistically significant under low levels of ICT penetration, that is, when $ICT_{it} \leq 0.15$. However, the point estimates suggest a positive impact on inclusive growth when ICTs surpass the threshold of $\hat{\gamma} = 0.15$. We note that the impact of financial inclusion on growth strategy is significantly positive across both ICT regimes. However, we can confirm that the impact is more pronounced under high ICT diffusion, that is, when $ICT_{it} > 0.15$.

Our results corroborate those of Wang et al. (2023), who confirmed the mediating effect of ICT in a panel of ten African countries. They reported that a 1% increase in the interaction term between ICT and financial inclusion leads to a 0.104% increase in inclusive growth. We note that the use of the panel threshold in our study provides additional flexibility because it allows the mediating effect to be captured without imposing any prior form on the relationship between financial inclusion and inclusive growth. Financial inclusion, institutional quality, and ICTs are complementary; together, they can play a critical role in achieving greater equity and shared economic opportunities. Policymakers are called upon to harness the combined impact of financial inclusion, governance quality, and ICTs to ensure inclusive economic growth. Within a robust governance framework, enabling ICT innovation and enhancing access to financial services are of paramount importance for successful inclusive growth strategies.

Figure 4. Financial inclusion and the estimated threshold value



Notes: The plots represent the financial inclusion index in our panel of 67 countries over the annual period 2010–2019. The black dashed line represents the estimated threshold level of financial inclusion, $\hat{\gamma} = 0.6$.

4. Conclusion

This study investigated how financial inclusion, institutional quality, and ICT infrastructure affect the extent of inclusive growth using recent panel data techniques. Specifically, we assessed their complementary effects on enhancing equality and welfare. Our study was conducted using a sample of 67 countries for the period 2010–2019. First, we applied the MMQR estimator to examine the heterogeneous and distributional impact of financial inclusion, among other factors, on inclusive growth across quantiles. Our results suggest that the distributional effects of financial inclusion, institutional quality, and ICT diffusion are statistically significant only in the lower tail of the conditional distribution. Although both financial inclusion and ICT are detrimental to inclusive growth, institutional quality is conducive to greater shared prosperity. Better institutional quality is only beneficial for

countries with low inclusiveness levels but is not significant for countries with higher levels of equality.

Next, we examined this puzzle by investigating the possible existence of threshold effects in the transition to inclusive and sustainable growth. We experimented with an alternative approach, the non-linear panel threshold regression model, in which interaction between the variables was allowed. Our results highlight the mediating role of financial inclusion in achieving more inclusive and sustainable growth. While ICT infrastructure negatively impacts growth inclusiveness at low financial inclusion levels, a positive relationship is observed when financial affordability exceeds a certain threshold. Similarly, our results confirm the moderating roles of governance quality and ICT diffusion on inclusive growth. Particularly, the relationship between governance mechanisms and inclusiveness is asymmetric, depending on ICT infrastructure development. Our study highlights that the combined benefits of financial inclusion, institutional quality, and ICTs, which are complementary, play a crucial role in achieving greater equity and shared economic opportunities. Policymakers are called upon to harness the combined impacts of financial inclusion, governance quality, and ICTs to ensure inclusive economic growth. Within a sound governance framework, enabling ICT innovation and improving access to financial services are paramount to successful inclusive growth strategies.

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Appendix

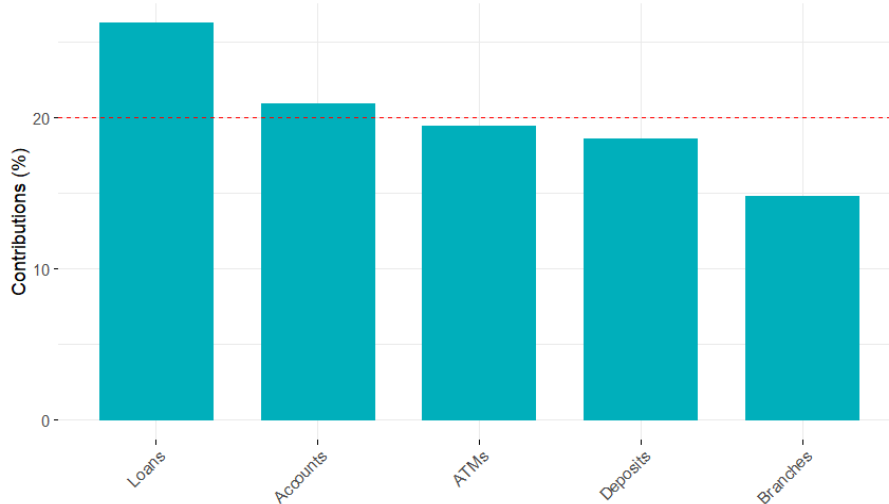
Table A1: Data definition and sources

Variable	Measurement	Source
Real GDP	GDP per capita (constant 2015 US\$)	World Development Indicators (WDI), The World Bank.
Financial inclusion	ATMs per 100,000 adults	Financial Access Survey (FAS), International Monetary Fund (IMF)
	Bank accounts per 1,000 adults	Financial Access Survey (FAS), International Monetary Fund (IMF)
	Bank branches per 100,000 adults	Financial Access Survey (FAS), International Monetary Fund (IMF)
	Outstanding deposits with commercial banks (% of GDP)	Financial Access Survey (FAS), International Monetary Fund (IMF)
	Outstanding loans from commercial banks (% of GDP)	Financial Access Survey (FAS), International Monetary Fund (IMF)
Domestic investment	Gross fixed capital formation (% of GDP)	World Development Indicators (WDI), The World Bank.
Government expenditure	General government consumption expenditure (% of GDP)	World Development Indicators (WDI), The World Bank.
Trade openness	Sum of exports and imports (% of GDP)	World Development Indicators (WDI), The World Bank.
Population	Population growth (annual %)	United Nations Statistical Division.
Unemployment	Unemployment, total (% of total labor force)	International Labour Organization.
Governance	Government Effectiveness	Worldwide Governance Indicators (WGI), The World Bank.
	Control of Corruption	Worldwide Governance Indicators (WGI), The World Bank.
	Political Stability and Absence of Violence/Terrorism	Worldwide Governance Indicators (WGI), The World Bank.
	Regulatory Quality	Worldwide Governance Indicators (WGI), The World Bank.
	Rule of Law	Worldwide Governance Indicators (WGI), The World Bank.
	Voice and Accountability	Worldwide Governance Indicators (WGI), The World Bank.
ICT infrastructure	Individuals using the Internet (% of population)	The World Telecommunication/ICT Indicators Database.
	Fixed telephone subscriptions (per 100 people)	The World Telecommunication/ICT Indicators Database.
	Mobile cellular subscriptions (per 100 people)	The World Telecommunication/ICT Indicators Database.

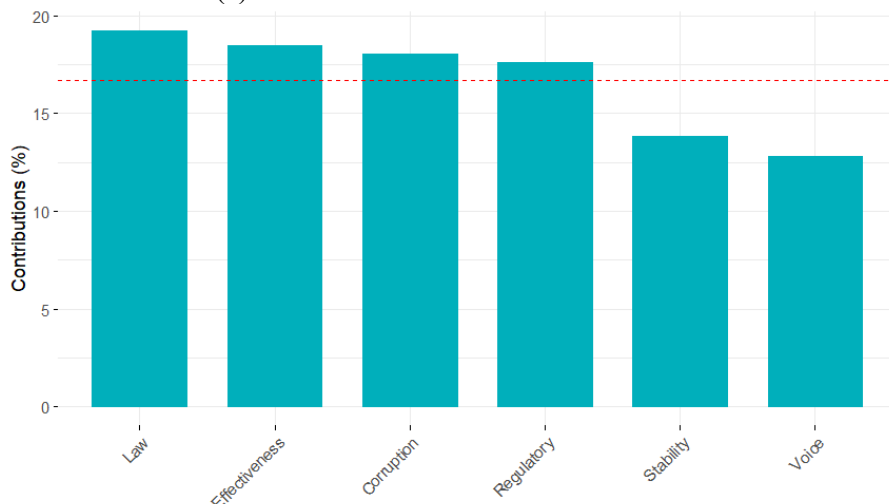
Table A2. List of countries based on World Bank region classification.

Geographic Region	Country	Geographic Region	Country	Geographic Region	Country	Geographic Region	Country
<i>East Asia and Pacific</i>	Indonesia	<i>High income (continued)</i>	Greece	<i>Latin America and the Caribbean</i>	Bolivia	<i>South Asia</i>	Bangladesh
	Malaysia		Hungary		Chile		Bhutan
	Mongolia		Ireland		Colombia		India
	Philippines		Italy		Costa Rica		Pakistan
	Thailand		Japan		Ecuador		Cameroon
<i>Europe and Central Asia</i>	Armenia	Korea	El Salvador	<i>Sub-Saharan Africa</i>	Gambia		
	Bosnia	Latvia	Honduras		Ghana		
	Bulgaria	Malta	Mexico		Kenya		
	Georgia	Netherlands	Nicaragua		Mauritius		
	Montenegro	Poland	Panama		Mozambique		
	North Macedonia	Portugal	Paraguay		Namibia		
	Türkiye	Qatar	Peru		Rwanda		
	Ukraine	Singapore	Algeria		Senegal		
	<i>High income</i>	Austria	Spain		<i>Middle East and North Africa</i>	Egypt	South Africa
		Belgium	Sweden			Lebanon	Togo
Croatia		Switzerland	Morocco	Uganda			
Estonia		UAE		Zambia			

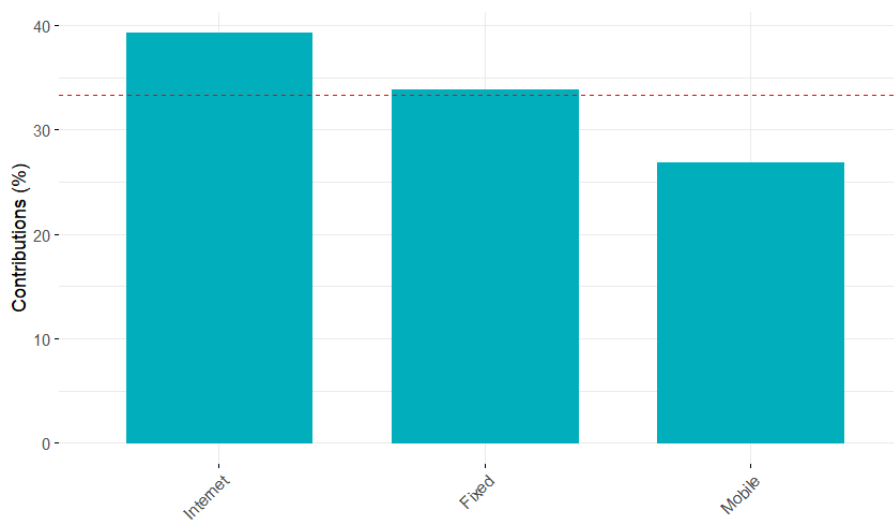
Figure A1. Contribution of variables in the first component



(a) Contributions of financial inclusion variables



(b) Contributions of governance variables



(c) Contributions of ICT variables

Note: The red dashed line above shows the expected average contribution of each variable to the principal component. For instance, the expected value for the financial inclusion variables is $1/5$ (20%). A variable with a contribution greater than this threshold could be considered a key contributor to the component.