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Abstract

This paper examines how financial inclusion, among other factors, shapes the transition to inclusive and sustainable growth in a sample of 67 countries. We first analyze the heterogeneous and asymmetric relationship between inclusiveness and its main determinants using recent panel quantile regression techniques. Our results suggest that the distributional effect of financial inclusion, institutional quality and ICT diffusion is statistically significant only in the lower tail of the conditional distribution. While both financial inclusion and ICT are detrimental to inclusive growth, institutional quality appears to be conducive to greater shared prosperity. We next examine the existence of mediating effect in the process of inclusiveness using nonlinear panel threshold modelling. Our results highlight the mediating role of financial inclusion in achieving more inclusive and sustainable growth. While ICT infrastructure has a negative impact on growth inclusiveness at low levels of financial inclusion, a positive relationship is found when financial affordability exceeds a certain threshold. Policymakers are called upon to harness the combined impact of financial inclusion, governance quality and ICTs to ensure the inclusiveness of economic growth.

Keywords: Inclusive growth, financial inclusion; nonlinear panel data modelling.
JEL Classifications: C23; O11, O16, O43.

ملخص

تبحث هذه الورقة البحثية في كيفية تأثير الشمول المالي، من بين عوامل أخرى، على عملية الانتقال إلى النمو الشامل والمستدام في عينة مكونة من 67 دولة. نقوم أولاً بتحليل العلاقة غير المتجانسة وغير المتماثلة بين الشمولية ومحدداتها الرئيسية باستخدام تقنيات الانحدار الكمي الحديثة. تشير نتائجنا إلى أن التأثير التوزيعي للشمول المالي والجودة المؤسسية وانتشار تكنولوجيا المعلومات والاتصالات له أهمية إحصائية فقط في الذيل السفلي للتوزيع المشروط. ورغم أن الشمول المالي وتكنولوجيا المعلومات والاتصالات يضران بالنمو الشامل، فإن جودة المؤسسات تبدو مواتية لتحقيق قدر أعظم من الرخاء المشترك. سنقوم بعد ذلك بفحص وجود تأثير وسيط في عملية الشمولية باستخدام نمذجة عتبة اللوحة غير الخطية. تسلط نتائجنا الضوء على الدور الوسيط الذي يلعبه الشمول المالي في تحقيق نمو أكثر شمولاً واستدامة. وفي حين أن البنية التحتية لتكنولوجيا المعلومات والاتصالات لها تأثير سلبي على شمولية النمو عند مستويات منخفضة من الشمول المالي، إلا أنه توجد علاقة إيجابية عندما تتجاوز القدرة المالية على تحمل التكاليف عتبة معينة. ويُطلب من صناع السياسات الاستفادة من التأثير المشترك للشمول المالي وجودة الحوكمة وتكنولوجيا المعلومات والاتصالات لضمان شمول النمو الاقتصادي.

1. Introduction

Achieving long-term economic growth and prosperity while ensuring equal opportunities for all is a major challenge for policymakers. The 2030 Sustainable Development Goals (SDGs) include a number of elements related to inclusive growth, particularly in the context of SDG 8, which seeks to "*promote Sustained, Inclusive, and Sustainable Growth, Full and Productive Employment, and Decent Work for All*." (United Nations, 2015).[3] Indeed, there are still wide disparities in terms of inclusiveness between regions of the world, with the lack of opportunities in developing countries almost twice as great as in developed countries (UNCTAD, 2022).[4] The process of inclusive growth is complex, where different socio-economic factors can interact with the wide heterogeneity of countries in terms of living conditions and inequalities. For policymakers to identify strategies for inclusive development, it is essential that they are informed by rigorous research on the drivers of successful growth strategies.

The empirical literature on this subject is still in its infancy, with various economic factors identified as drivers of greater shared prosperity. For selected 10 Asian countries, Pham et al. (2024) documented the key role of the financial system and effective natural resource management in enhancing inclusiveness using the cross-sectionally augmented autoregressive distributed lag (CS-ARDL) model of Chudik et al. (2016). Similarly, Chen et al. (2023) report that increased access to finance is critical for economic growth in a sample of countries with high levels of financial inclusion. Although some studies identified the financial sector as crucial to promoting inclusiveness, others argued that greater access to finance can be a barrier beyond a certain threshold. For a sample of 44 Sub-Saharan African (SSA) countries, Amponsah et al. (2021) found that financial inclusion exhibits an inverted-U-shaped relationship with inclusive growth; that is, an increase in financial inclusion increases inclusive growth up to a threshold and thereafter declines. Using the two-step efficient generalized method of moments (GMM) estimator of Baum et al. (2003, 2007), the authors emphasized on the moderating role of financial inclusion in the impact of informality on inclusive growth. Also, the authors emphasized the role of robust governance framework in promoting inclusiveness. Arcand et al. (2012) confirmed the existence of a threshold above which higher levels of financial development—proxied by private credit as a fraction of GDP—begins to have a negative impact on economic growth.

However, other studies report different dynamics of the growth-finance nexus in terms of the existence of a threshold. For a sample of 42 African countries, Ofori et al. (2023) used a system GMM procedure of Arellano and Bover (1995) and Blundell and Bond (1998) to examine how the interaction between financial development and remittances affects growth inclusiveness. The

[3] United Nations (2015). Transforming our world: the 2030 Agenda for Sustainable Development. No. A/RES/70/1. New York.

[4] UNCTAD (2022). In focus: Inclusive growth, Stark contrasts in inclusive growth – progress towards equal opportunities needed everywhere. In SDG Pulse 2022. Available at: https://sdgpulse.unctad.org/inclusive-growth/

authors found that there is a threshold above which the financial sector becomes effective in ensuring equal economic opportunity. It is worth noting that the (GMM) estimator is the panel data estimator often used to study the dynamics of inclusive growth. For the case of 27 sub-Saharan African countries, Oyinlola et al. (2020) investigated the role of governance in the resource mobilization-inclusive growth relationship. Using the difference GMM estimator of Arellano and Bond (1991), the authors have introduced an interaction term to capture the moderating role of governance in resource mobilization-inclusive growth relationship.[5] In a similar vein, Wang et al. (2023) confirmed the mediating effect of ICT (information and communication technology) in the relationship between financial inclusion and inclusive growth. For the top 10 African countries in terms of ICT infrastructure, the authors used interactive terms in their dynamic panel data model to assess the combined benefits of ICT and financial inclusion in promoting inclusiveness. The existing literature remains inconclusive on how the process of inclusive growth is affected by the various factors identified. Both advanced and developing country groups have heterogeneous profiles in terms of shared prosperity, which may lead to asymmetry or non-linearity in the dynamics of inclusive growth. The presence of heterogenous or time-varying relationships tends to be masked when using standard linear panel data modelling.

In this study, we examine how financial inclusion, institutional quality and ICT infrastructure affect the extent of inclusive growth using recent panel data techniques. In particular, we assess their complementary effects on how they would enhance equality and welfare. As a first step, our study applies the Method of Moments-Quantile Regression (MM- QR) of Machado and Silva (2019) to examine the heterogeneous and distributional impact of financial inclusion, among other factors, on inclusive growth across quantiles. The procedure is much easier to implement in the context of panel data models with fixed effects, compared to the computational complexity of other quantile methods (see e.g., Canay, 2011, Galvão, 2011, and Powell, 2016). The MM-QR estimator is less restrictive as it allows the fixed effects to affect the entire conditional quantiles.[6] In the next step, we implement nonlinear panel threshold modelling in line with Kremer, et al. (2013) and Seo and Shin (2016). By doing so, it is possible to assess the presence of a threshold effect in the process of inclusion, while allowing for interactions among our variables of interest. Our study covers a sample of 67 countries over the period 2010-2019, for which data on inclusive growth and its main drivers are available.

[5] In a related literature, Hathroubi (2019) examined the causal relationships between financial inclusion and standard measures of economic development and economic well-being in the context of an oil-based economy, namely Saudi Arabia. Using GMM methodology, the author pointed out that financial inclusion is highly and positively correlated with the human development index and the share of the adult population in employment. Furthermore, taking into account the presence of threshold effects within a threshold vector error correction model, he also showed that there is a non-linear causal relationship between financial inclusion, human development and economic growth in the long run.

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

The rest of the paper is structured as follows: Section 2 presents the collected data and discusses their properties. Section 3 discusses the different empirical strategies used in this study. Section 4 provides some concluding remarks.

2. Data description

As we focus on the dynamics of inclusive growth, selecting a relevant measure is crucial for our empirical analysis. There are different measures for inclusiveness that have been proposed in the previous empirical literature. For sample of 37 Sub-Saharan African economies, Adejumo et al. (2020) investigated the role of technological developments and innovations in enhancing the inclusive growth. The authors considered three measures for inclusive growth which are income growth per capita, inequality-adjusted human development index (IHDI) and unemployment. However, using the IHDI as a dependent variable may introduce redundancy or overlap with explanatory variables included in our empirical specification, such as education and income metrics. In a recent study, Jinapor et al. (2025) used the Asian Development Bank's framework to evaluate inclusive growth across 32 Sub-Saharan African countries. They employed principal component analysis (PCA) to construct a composite index from 18 variables reflecting various dimensions of inclusiveness—such as economic growth, inequality, access to education and healthcare, energy consumption, and governance.

In our case, we prefer not to use a composite index of inclusive growth as the dependent variable, since PCA-based indices are already used as key explanatory variables in our empirical model, specifically for financial inclusion, ICT infrastructure, and governance quality. Other empirical studies have followed the approach proposed by Anand et al. (2013), who introduced the concept of a social mobility function to measure inclusive growth (see, for example, Badmus et al., 2024; Epo et al., 2025).

Besides, the logarithm of real GDP per person employed in a country has been used as a proxy for the 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). The measure of GDP per person employed would allow to capture the ability of a country to create and achieve fair and equitable opportunities for the population. GDP per person employed is indeed a narrow indicator that does not capture all dimensions of inclusiveness, such as inequality or access to essential services. However, it serves as a practical proxy, as it emphasizes the economic and employment aspects of inclusivity while avoiding redundancy or overlap with the explanatory variables included in the model. In our empirical specification, we have chosen to use GDP per person employed (Δyit) as an alternative measure of inclusive growth which reflects the opportunities available to the population and how these opportunities are distributed. Data on inclusive growth are collected for 67 countries for the period 2010-2019. Table A2 shows 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 our panel data.

Table 1. Summary of 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 labor force)	7.95	6.41	0.10	3.64	5.57	10.14	32.02
Financial inclusion indicators							
ATMs	52.21	44.17	0.77	21.61	49.68	67.81	288.59
Bank branches	18.47	15.30	0.41	8.30	14.14	23.60	95.93
Bank accounts	1453.29	1244.94	54.12	632.39	1109.13	1925.91	7270.62
Deposits (% of GDP)	60.38	40.73	11.13	35.08	46.98	74.03	251.26
Loans (% of GDP)	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							
Government Effectiveness	0.13	0.76	-1.33	-0.47	0.07	0.62	2.32
Control of Corruption	-0.04	0.82	-1.34	-0.64	-0.25	0.46	2.17
Political Stability	-0.13	0.82	-2.81	-0.68	-0.10	0.55	1.62
Regulatory Quality	0.20	0.73	-1.37	-0.30	0.10	0.68	2.26
Rule of Law	0.01	0.78	-1.49	-0.57	-0.14	0.51	1.97
Voice and Accountability	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							
Fixed telephone subscriptions	18.98	16.06	0.09	5.18	15.46	30.13	62.85
Individuals using the Internet	50.14	27.38	3.00	25.00	52.41	73.43	99.65
Mobile cellular subscriptions	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 are collected for 67 countries for the annual period 2010–2019. SD, min., max., Q1 (.25), and Q3 (.75) are the standard deviation, minimum, maximum, first quartile, and third quartile, respectively.

Similarly, a number of measures of financial inclusion have been used in the extant literature.[7] The existing literature argues that the measurement of financial inclusion should take into account multiple aspects and cannot be captured by a single indicator. Mainly, three basic dimensions should be considered including, the criteria of accessibility (banking penetration), availability of the banking services and usage of banking services (see e.g., Sarma, 2008; Sarma and Pais, 2011).[8] The most used indicators in the empirical literature include number of bank branches (per capita), number of ATMs, number of bank account or number of credit card (see e.g., Abdul Karim et al., 2022; Emara and El Said, 2021). In the case of our paper, 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); (5) Outstanding loans from commercial banks (% of GDP). Data on financial inclusion are obtained from the International Monetary Fund's (IMF) Financial Access Survey.

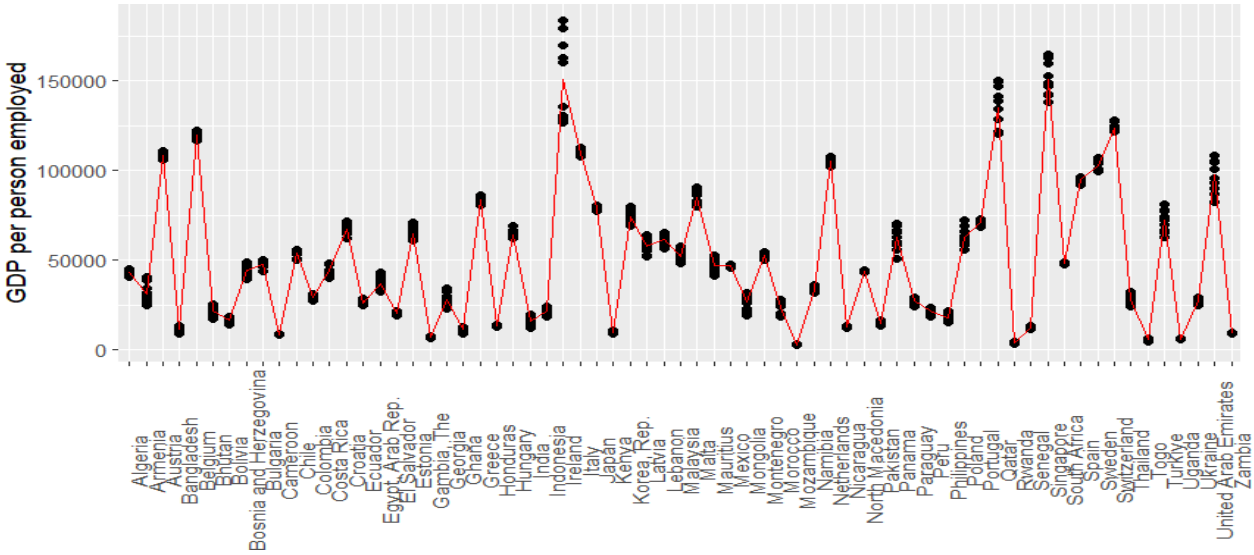
[7] Amponsah et al. (2021) computed a measure of financial inclusion using data from the IMF's Financial Access Survey (IMF, 2020). This follows the approach developed by Sarma (2008). The computed index measure ranges from 0 to 1, where 0 corresponds to no financial inclusion and 1 means higher financial inclusion.

[8] Other dimensions are used in the literature such as ease of transactions, cost of transactions, and the barrier to credit, (see e.g. Cao and Zhang, 2020).

We select a set of independent macroeconomic variables that may influence the dynamics of inclusive growth: domestic investment; government expenditure; population growth rate; unemployment rate; trade openness. Also, as institutional quality would influence inclusive growth strategies, we follow Amponsah et al. (2021) by considering six dimensions of governance: (1) control of corruption; (2) government effectiveness; (3) political stability; (4) regulatory quality; (5) rule of law; (6) and voice and accountability.[9] For the investments in ICT, three different measures are used here: fixed telephone subscriptions (per 100 people); mobile cellular subscriptions (per 100 people); individuals using the Internet (% of population). Governance indicators are sourced from the World Governance Indicators (WGI) database of the World Bank. ICT and macroeconomic variables are sourced from World Development Indicators (WDI) of the World Bank.

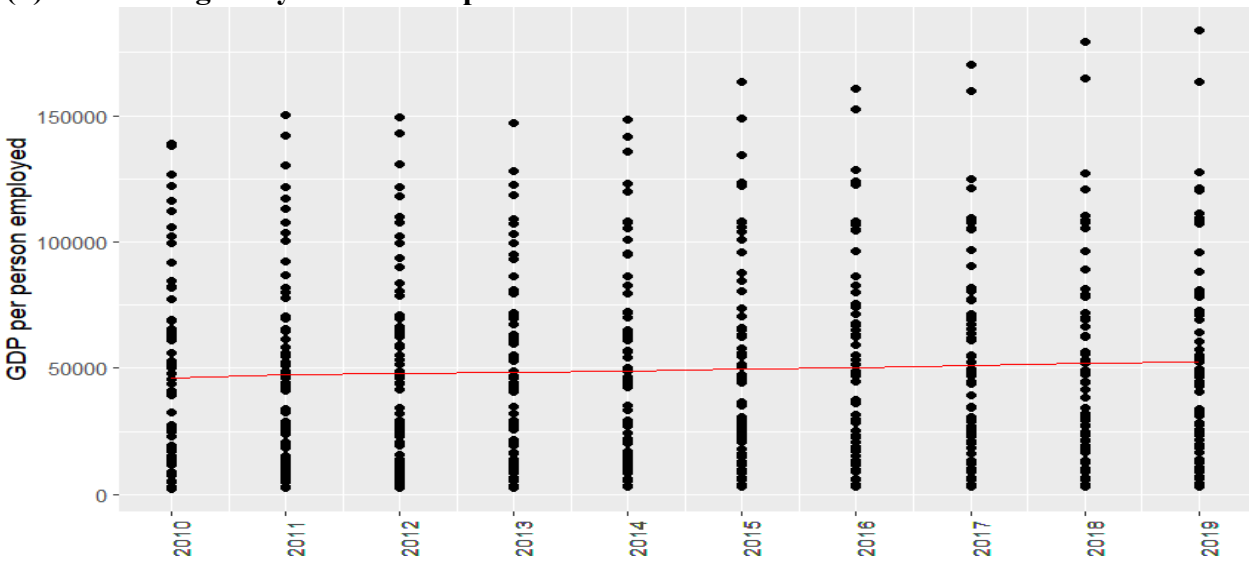
Figure 1. The heterogeneity of inclusiveness in the panel data

(a) Heterogeneity across countries



[9] For 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 financial inclusion-growth nexus, where the governance indicator index is computed using the principal component analysis of six main dimensions.

(b) Heterogeneity across time periods



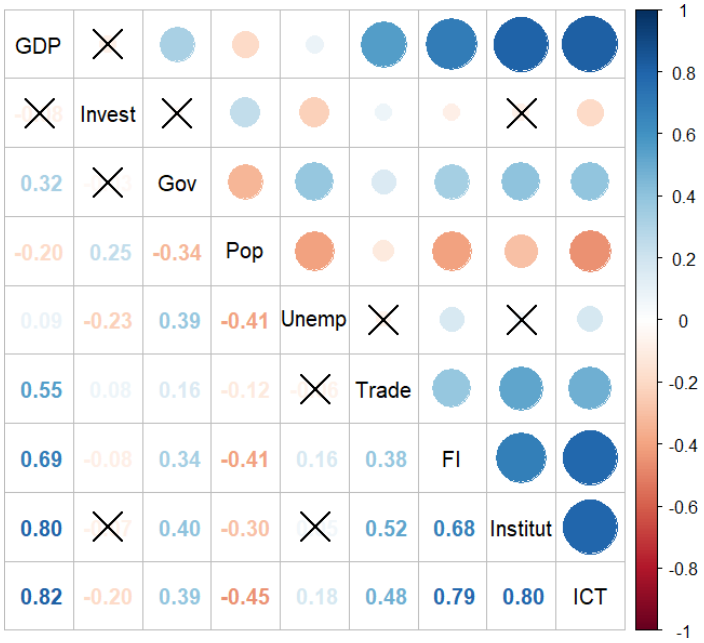
Notes: Plots represent the average GDP per person employed in our panel of 67 countries and over the annual period 2010-2019.

Composite indices were constructed using PCA to proxy for financial inclusion, governance quality, and ICT infrastructure. PCA is a useful tool for data reduction, enabling us to extract valuable information from large datasets. The principal components provided are orthogonal, with the earlier components retaining most of the information. Details of the eigenvalues for each individual principal component are given in Table 2.[10] For example, we can see that the first component of the financial inclusion variables 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), which is less than the cutoff of 1, representing only 18.4% of the total variation. It is clear that the first principal component is the best representation of our financial inclusion data set. The same applies to governance and ICT data, where the first principal component retains more than 70% of the total variance. Figure A1 in Appendix displays the contribution of each variable in the first component. For the case of financial inclusion variables, the ratio of outstanding bank loans and the number of bank accounts stand as the most contributors to the first principal component. Each variable has contributed more than 20% to the first component, which is the expected average contribution (see the red dashed line in Figure A1).[11]

[10] The eigenvalues measure the amount of variance each principal component retains.

[11] We checked the relevance of our data for PCA using Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. Results are not reported here to save space but can be made available upon request.

Figure 2. Correlation matrix of key variables



Notes: The correlogram above reports correlations among the key variables over the annual period 2010-2019. The crossed numbers correspond to non-significant correlation coefficients.

All variables are transformed into natural logarithms except for the composite indices and the variables in growth rates and shares. The summary statistics of the key variables is provided in Table 1. Full details of the definition and sources of the data are reported in the Appendix in Table A1. Figure 2 provides the correlation matrix which traces out the co-movement among our key variables. The measure of inclusive growth is strongly and positively correlated with financial inclusion, ICT, and institutional quality. It is intrigant to see that domestic investment is not significantly correlated with measures of inclusiveness and governance and negatively linked to financial access and ICT indices. Indeed, a negative effect of domestic investment is plausible if the increased domestic capital accumulation leads to an inequitable allocation of resources. Of course, results from correlation analysis should be treated with caution. Our panel data show a high degree of heterogeneity, which should rather be modelled in a non-linear framework.[12]

[12] 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. Also, the procedure has the advantage to allow for cross-section dependence and cross-section heteroskedasticity. The results of panel unit root tests confirm the stationarity of our variables of interest. The results are not reported here for reasons of space but are available upon request.

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: The eigenvalues measure the amount of variation retained by each principal component. The percentage of variation explained by each eigenvalue is given in the second column. For example, 2.84 divided by 5 equals 56.87% of the variation is explained by this first eigenvalue. The cumulative percentage explained is obtained by adding the successive proportions of variation explained to obtain the running total.

3. Empirical strategy and main results

3.1. Results from linear dynamic panel data

As discussed above, the relationship between inclusive growth and access to finance is found to be country-specific and time-varying. Differences in period of time and sample of countries considered would yield different outcomes. We then start 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 stands for the cross-sections and t for time period. α_i are cross-section fixed effects, X_{it} is a vector of explanatory variables that may influence the inclusive growth Δy_{it}, including 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. Estimation is also carried out for a group of 20 high-income countries versus a group of 47 emerging market and developing economies (EMDEs). Eq. (1) is estimated using the system GMM method of Arellano and Bover (1995) and Blundell and Bond (1998). The two standard diagnostic tests for the reliability of the GMM estimator—the serial correlation test and Hansen's (1982) J-test of overidentification restriction—were carried out. As reported in Table 3, p-values in square brackets indicate that both the null of no autocorrelation and the null of valid overidentification conditions could not be rejected at the 5% significance level.

The system GMM estimates provided in Table 3 indicates the impact of the main macroeconomic variables—domestic investment, government expenditure, and trade openness—is consistent

across the different time periods, and the group of countries, i.e., high-income countries versus EMDEs. The only exception is the unemployment rate, where 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 appear to have a time-varying relationship with inclusive growth, which also varies across the group of countries. Better governance quality is found to increase inclusiveness over the 2015-2019 period and for high-income countries. Surprisingly, improved access to finance is detrimental to inclusive growth, and for the sample of 47 emerging and developing countries. Affordability of financial services has no significant impact on the panel of 20 advanced economies. It is worth noting that 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 have also examined the drivers of inclusive growth in different geographical regions, namely Latin America and the Caribbean (LAC), the Middle East and North Africa (MENA) and Sub-Saharan Africa (SSA). Our panel data set includes 12 countries from Latin America and the Caribbean, 7 from MENA and 13 from SSA.[13] Table 3 shows that the impact of financial inclusion, institutional quality and ICT diffusion varies across the group of countries. Financial access appears to increase inclusiveness for LAC countries at the 10% significance level. However, the opposite relationship is found for the SSA region, where financial inclusion reduces inclusive growth by 0.02% at the 1% significance level. The relationship is not statistically significant for MENA countries. In fact, we only have seven MENA countries in our panel data set, which may explain this result.

Indeed, previous studies have demonstrated the importance of financial inclusion for 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 as a proxy for income inequality. Furthermore, using disaggregated sectoral data, Rojas Cama and Emara (2022) underlined the beneficial role of widening financial coverage in the manufacturing industries depending on their R&D intensity. The authors revealed that financial inclusion enhances the level of gross capital formation, especially for low-R&D industries in the MENA region. Besides, the positive role of institutional quality is confirmed for both MENA and SSA. However, ICT infrastructure is found to have a positive impact on inclusive development only in the case of LAC countries.

[13] Our sample of seven MENA countries includes Qatar and the UAE, despite their classification as high-income countries by the World Bank.

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

Note: Results are obtained from linear dynamic panel data model as in equation (6). AR(2) test has the null hypothesis of no second-order serial correlation in the first-differenced residuals, while J-test has the null of valid overidentifying moment conditions, where p-values 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) highlight the specificity of access to financial products and services in the region. For example, the authors document a non-linear mechanism that takes the form of an inverted U-shaped curve between financial inclusion and trust in banks. For the top 10 financially inclusive MENA economies, Shen et al. (2024) investigated the possible asymmetric relationship between financial inclusion and economic growth. Using the quantile-on-quantile method of Sim & Zhou (2015), they pointed out that expanding financial access would boost growth in almost all conditional quantiles, although there is considerable heterogeneity across MENA countries. Given the complexity of the economic development strategy, our study suggests the use of recent panel data techniques that can deal with possible heterogeneity and nonlinearity in growth inclusiveness.

3.2. Results from panel quantile regression models

The linear dynamic panel data analysis confirms the heterogeneous relationship between inclusive growth and its main determinants, especially financial inclusion and institutional quality. As a next step, we apply the MM-QR 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} has the following form:

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

where $i = 1, \ldots, 67$, $t = 1, \ldots, 10$. 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 ν_i are the country-specific fixed effects. Z_{it} is a known differentiable transformation of X_{it} with l components expressed as:

$$Z^l_{it} = z_l(X_{it}), \qquad \text{with } l = 1, \ldots, k. \tag{3}$$

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:

$$Q_Y(\tau|X) = (\mu_i + \nu_i q(\tau)) + X'_{it}\beta + \nu_i + Z'_{it}\gamma q(\tau), \tag{4}$$

Eq. (4) is estimated using the MM-QR estimator of Machado and Silva (2019). 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, having the same impact across all quantiles (see e.g., Koenker, 2004, Canay, 2011). The MM-QR procedure allows the quantile fixed effect to have different impacts on the conditional distribution of the response variable. It is worth noting that the MM-QR procedure require large time-series observations (T) to produce reliable inference. Given the relative short time dimension of our panel data ($T = 10$), we have checked the robustness of the achieved results. We use the quantile regression estimator for panel data (QRPD) with nonadditive fixed effects of Powell (2022) which yield consistent estimates when T is small. Also, bias related to potentially endogenous explanatory variables can also be addressed using the QRPD estimator.

Results from the different panel quantile regression procedures are displayed in Table 4. The heterogenous effect of inclusive growth drivers is assessed through five different quantiles, namely, the 10th, 25th, 50th, 75th, and 90th quantiles, of the conditional distribution of the inclusive growth. A visual representation of the point estimates (with 95% confidence bands) across the range of conditional quantiles is provided in Figure 4. The MM-QR estimates indicate that the marginal effect of financial inclusion on growth inclusiveness is only statistically significant, and but negative, at the lower tail of the condition distribution, $\tau = 0.10$ and $\tau = 0.25$. Greater access to financial services is found to be detrimental for countries with low levels of growth inclusiveness,

but it is not significant for countries with a greater shared prosperity. This outcome has been confirmed using the QRPD estimator of Powell (2022).

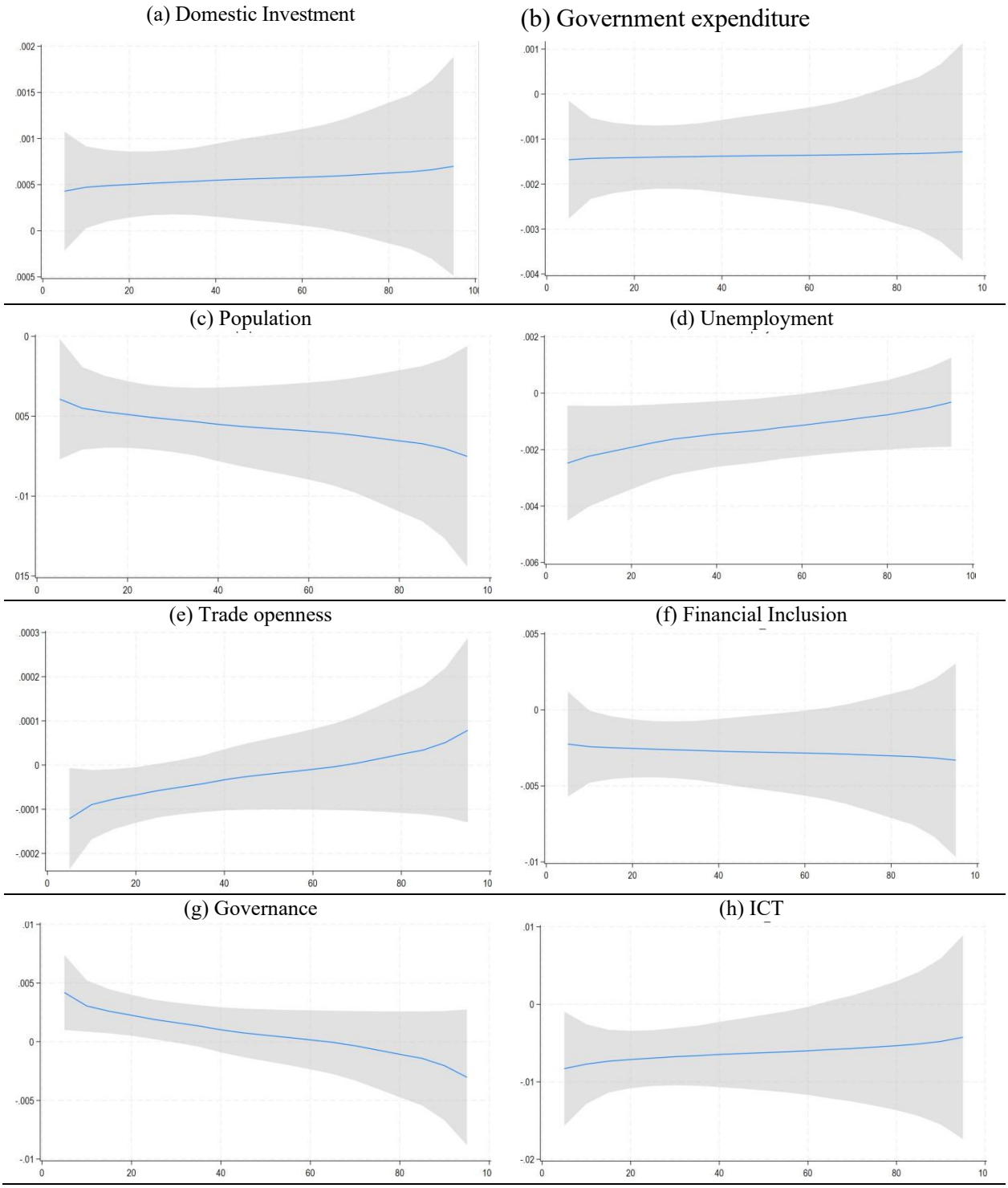
Table 4. Results from different panel quantile regression models

Dependent variable: Inclusive growth

	$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.50$	$\tau = 0.75$	$\tau = 0.90$
MM-QR of Machado and Silva (2019)					
Lagged inclusive growth	0.2762***	0.2681***	0.258***	0.2496***	.2401*
	(0.0622)	(0.0484)	(0.0643)	(0.0964)	(0.1360)
Domestic investment	0.0004**	0.0005***	0.0005**	0.0006*	0.0006
	(0.0002)	(0.0001)	(0.0002)	(0.0003)	(0.0004)
Government expenditure	-0.0014***	-0.0014***	-0.0013***	-0.0013*	-.0013063
	(0.0004)	(0.0003)	(0.0004)	(0.0007)	(0.0010)
Population	-0.004***	-0.0050***	-.0057***	-0.0063***	-0.0070**
	(0.0013)	(0.0010)	(0.0013)	(0.0020)	(0.0028)
Unemployment	-0.0022**	-0.0017**	-0.0013**	-0.0008	-0.0004
	(0.0009)	(0.0006)	(0.0005)	(0.0006)	(0.0007)
Trade openness	-0.0008**	-0.0005*	-0.0002	0.0001	0.0004
	(0.0004)	(0.0003)	(0.0004)	(0.0006)	(0.0008)
Financial Inclusion	-0.0024**	-0.0025***	-0.0027**	-0.0029	-0.0031
	(0.0012)	(0.0009)	(0.0012)	(0.0018)	(0.0026)
Governance	0.0030***	0.0018**	0.0005	-0.0007	-0.0020
	(0.0011)	(0.0008)	(0.0011)	(0.0016)	(0.0023)
ICT	-0.0077***	-0.0069***	-0.0062**	-0.0055	-0.0047
	(0.0026)	(0.0018)	(0.0024)	(0.0038)	(0.0054)
QRPD of Powell (2022)					
Lagged inclusive growth	0.3139***	0.2387***	0.2793***	0.2171***	0.1947***
Domestic investment Government	(0.058)	(0.0505)	(0.0607)	(0.0621)	(0.0423)
expenditure Population	0.0005***	0.0004**	0.0007***	0.0005*	0.0007*
	(0.0001)	(0.0001)	(0.0001)	(0.0003)	(0.0004)
	-0.0011***	-0.0009***	-0.0011***	-0.0016***	-0.0016*
	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0010)
	-0.0065***	-.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 between brackets, except for MM-QR where clustered standard errors are reported. ***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.*

Figure 3. Plots of the coefficients for the different quantiles



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

Similarly, ICT diffusion appears to affect negatively the adoption of inclusive growth strategy, having negative effects in lower quantiles, but also in the middle of the conditional distribution (τ

$= 0.50$). The quality of governance is found to play a beneficial role, with significant positive effects in the lower quantiles of the inclusiveness distribution. Governance factors, including the quality of policy formulation and implementation, play a crucial role in promoting inclusiveness for countries with low equal opportunities. The rest of the 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, where most of them are insignificant. Given the unexpected negative signs of financial inclusion and ICT in their relationship with growth inclusiveness, we suggest using a different nonlinear panel data framework where we can test the possible moderating role of these variables.

3.3. Results from dynamic threshold panel data model

As seen above, surprisingly, financial inclusion and ICT diffusion appear to be detrimental to inclusiveness, which is a counterintuitive result. As a final step, we propose to address 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 nonlinear panel threshold regression model in line with Kremer, et al. (2013) and Seo and Shin (2016), where the interaction between our variables of interest is allowed. A nonlinear panel data model with a single threshold (two regimes) can be written for 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 time-varying explanatory variables that may influence the inclusive growth y_{it}, including the 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 the dynamics of inclusive growth and which can be directly interacted 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-differenced generalized method of moments (FD-GMM) approach which allows both threshold variable and regressors to be endogenous.

Table 5. Results from 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***	0.8045***	0.1482***
	(0.1538)	(0.1033)	(0.0228)
Lagged inclusive growth	0.1954***	0.3679**	0.2442***
Domestic investment Government	(0.0538)	(0.1548)	(0.0229)
expenditure	0.0021***	0.0018***	0.0017****
Population	(0.0003)	(0.0003)	(0.0003)
	-0.0113***	-0.0110***	-0.0106***
	(0.0009)	(0.0009)	(0.0009)
	-0.0054**	-0.0048**	-0.0044**
	(0.0022)	(0.0022)	(0.0022)
Unemployment	0.0010	0.0005	0.0004
	(0.0007)	(0.0007)	(0.0007)
Trade openness	0.0010***	0.0010***	0.0009***
	(0.00013)	(0.0001)	(0.0001)
Lower regime:			
Financial Inclusion		-0.0037	0.0141***
		(0.0028)	(0.0050)
Governance	0.0040		-0.0268
	(0.0036)		(0.0210)
ICT	-0.0202***	-0.0123**	
	(0.0062)	(0.0049)	
Upper regime:			
Financial Inclusion		0.0512***	0.0640***
		.0140273	(0.0146)
Governance	0.0164**		0.0288***
	(0.0069)		(0.0049)
ICT	0.0329***	0.2712***	
	(0.0085)	(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 are obtained from the dynamic panel threshold model as specified in equation (9) over the period 2010–2019. 95% confidence intervals are reported between braces. For the linearity test the bootstrap p-values of the supW test are reported in addition to J-test of the validity of the overidentifying moment conditions with p-values between square brackets. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.*

Results from the different panel threshold specifications are displayed in Table 5.[14] When considering financial inclusion as a threshold variable, we note that the effect of institutional quality is not significant in lower regime, i.e., $FI_{it} \leq 0.6$. However, when financial access exceeds the estimated threshold $\hat{\gamma} = 0.6$, there is a significant positive impact of governance framework on the inclusive growth. The impact of ICT penetration on the extent of inclusiveness is found to be asymmetric with respect to level of financial affordability. Point estimates indicate a negative impact which is statistically significant under the low-financial-inclusion regime. However, ICT has a positive and significant impact on the adoption of more inclusive growth at higher levels of financial access. As shown in Figure 4, there is a significant disparity in access to finance across regions. High-income countries exhibit higher levels of financial coverage, while the Sub-Saharan Africa (SSA) region lags behind, with financial inclusion levels falling below the estimated threshold. Our empirical findings highlight that inclusive growth can be more effectively achieved

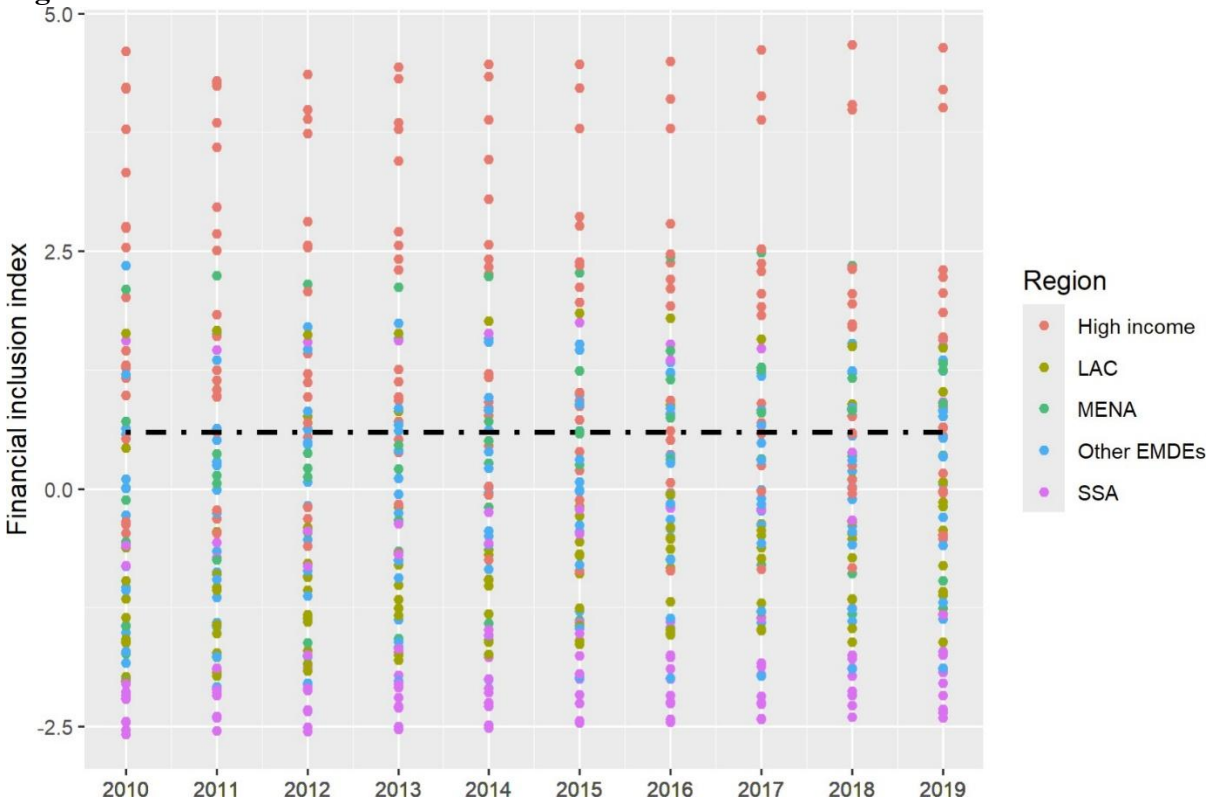
[14] [13] As we focus on the mediating effect of financial inclusion, institutional quality, and ICT, we do not report the coefficients on the other variables in the upper regimes for reasons of space.

through improved governance and ICT development—provided that access to finance is sufficiently enhanced. In this context, a successful inclusive growth strategy in developing countries depends critically on expanding access to credit and banking services.

The quality of institutions 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 a better quality of institutions, i.e., $GOV_{it} > 0.8$, the relationship between ICT penetration and the inclusiveness becomes significantly positive. As for financial inclusion, the moderating role of institutional quality is also confirmed. While the impact of access to finance is not statistically significant under lower governance quality, a significant positive relationship is found 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. In particular, the relationship between institutional quality and inclusiveness is changing depending on the development of ICT infrastructure. The impact of quality of governance is not statistically significant under low levels of ICT penetration, i.e. 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 i.e. 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 10 African countries. The authors 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, as it allows the mediating effect to be captured without imposing any prior form on the relationship between financial inclusion and inclusive growth. It is clear that financial inclusion, institutional quality, and ICTs are complementary, and 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 the inclusiveness of economic growth. Within a robust governance framework, enabling ICT innovations and enhancing access to financial services are of paramount importance for a successful inclusive growth strategy.

Figure 4. Financial inclusion and the estimated threshold value



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

4. Conclusion

In this paper, we have investigated how financial inclusion, institutional quality and ICT infrastructure affect the extent of inclusive growth using recent panel data techniques. In particular, we assess their complementary effects on how they would enhance equality and welfare. Our empirical exercise was conducted for a sample of 67 countries over the period 2010-2019. As a first step, we applied the MM-QR 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 effect of financial inclusion, institutional quality and ICT diffusion is statistically significant only in the lower tail of the conditional distribution. While both financial inclusion and ICT are detrimental to inclusive growth, institutional quality appears to be conducive to greater shared prosperity. Better institutional quality is only beneficial for countries with low levels of inclusiveness but is not significant for countries with higher levels of equality.

In the next step, we propose addressing this puzzle by investigating the possible existence of threshold effects in the transition to inclusive and sustainable growth. We experiment with an alternative approach, the nonlinear panel threshold regression model, where the interaction between our variables of interest is allowed. Our results highlight the mediating role of financial inclusion

in achieving more inclusive and sustainable growth. While ICT infrastructure has a negative impact on growth inclusiveness at low levels of financial inclusion, a positive relationship is found when financial affordability exceeds a certain threshold. Similarly, our results also confirm the moderating role of governance quality and ICT diffusion in the inclusive growth process. In particular, there is an asymmetric relationship between governance mechanism and inclusiveness depending on the development of ICT infrastructure. Our study highlights the combined benefits of financial inclusion, institutional quality and ICTs, which are complementary and together can play a crucial role in achieving greater equity and shared economic opportunity. Policymakers are called upon to harness the combined impact of financial inclusion, governance quality and ICTs to ensure the inclusiveness of economic growth. Within a sound governance framework, enabling ICT innovations and improving access to financial services are paramount to a successful inclusive growth strategy.

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Appendix

Table A1: Data definition and sources

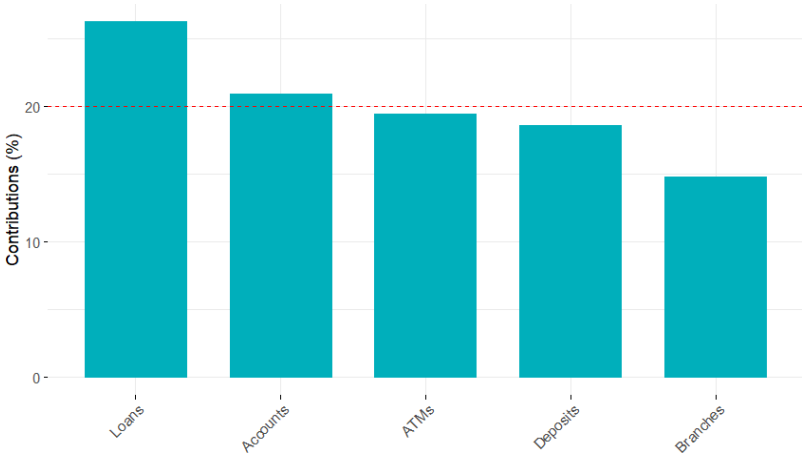
Variable	Measurement	Source
Real GDP	GDP per capita (constant 2015 US$)	World Development Indicators (WDI), The World Bank.
Financial inclusion	ATMs per 100,000 adults Bank accounts per 1,000 adults	Financial Access Survey (FAS), International Monetary Fund (IMF) Financial Access Survey (FAS), International Monetary
	Bank branches per 100,000 adults	Fund (IMF) 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 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.
		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

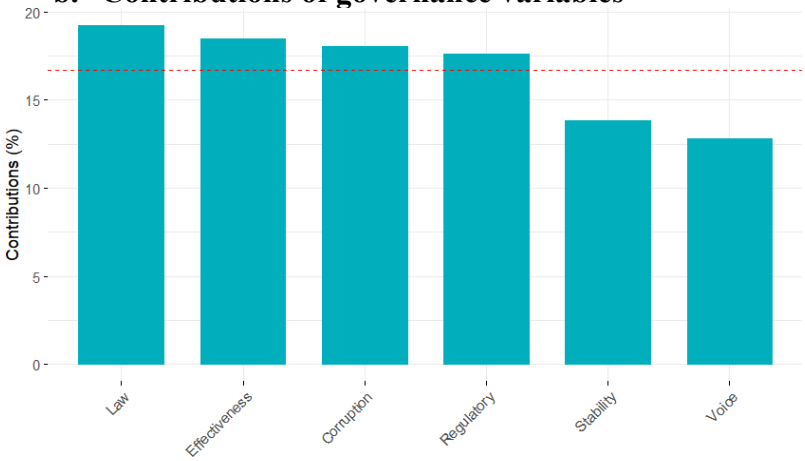
Geographic Region	Country	Geographic Region	Country	Geographic Region	Country	Geographic Region	Country
East Asia and	Indonesia	*High income (continued)*	Greece	*Latin America and*	Bolivia	*South Asia*	Bangladesh
Pacific	Malaysia		Hungary	*the Caribbean*	Chile		Bhutan India
	Mongolia		Ireland		Colombia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

Figure A1. Contribution of variables in the first component

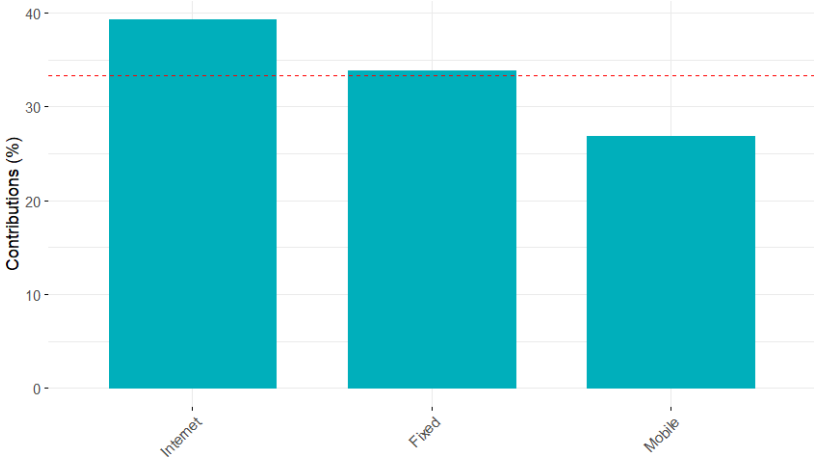
a. Contributions of financial inclusion variables



b. Contributions of governance variables



c. Contributions of ICT variables



Note: The red dashed line represents the expected average contribution of each variable to the principal component. For example, the expected contribution for each financial inclusion variable is 1/5 (20%). Any variable with a contribution exceeding this threshold can be considered a key contributor to the component.