Supplementary material

DIGITALIZATION AND CONFIGURATIONAL EFFECTS ON REGIONAL INCOME INEQUALITY: ANALYSIS OF PANEL DATA FROM 134 ECONOMIES

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Technological and Economic Development of Economy
https://doi.org/10.3846/tede.2025.23950

A. Sample information

A provides detailed information on the 134 economies included in our balanced panel dataset covering the years 2012 to 2021. The table lists each economy along with its corresponding code, geographical region, and World Bank income classification. The income groups are categorized into high income, upper-middle income, lower-middle income, and low income.

Table A1. List of economies by classification

Economy	Code	Region	Income group
Afghanistan	AFG	South Asia	Low income
Albania	ALB	Europe & Central Asia	Upper middle income
Algeria	DZA	Middle East & North Africa	Upper middle income
Angola	AGO	Sub-Saharan Africa	Lower middle income
Argentina	ARG	Latin America & Caribbean	Upper middle income
Armenia	ARM	Europe & Central Asia	Lower middle income
Australia	AUS	East Asia & Pacific	High income
Austria	AUT	Europe & Central Asia	High income
Azerbaijan	AZE	Europe & Central Asia	Upper middle income
Bangladesh	BGD	South Asia	Lower middle income
Barbados	BRB	Latin America & Caribbean	High income
Belarus	BLR	Europe & Central Asia	Upper middle income
Belgium	BEL	Europe & Central Asia	High income
Belize	BLZ	Latin America & Caribbean	Upper middle income
Bolivia	BOL	Latin America & Caribbean	Lower middle income
Bosnia and Herzegovina	BIH	Europe & Central Asia	Upper middle income
Botswana	BWA	Sub-Saharan Africa	Upper middle income
Brazil	BRA	Latin America & Caribbean	Upper middle income
Bulgaria	BGR	Europe & Central Asia	Upper middle income
Burundi	BDI	Sub-Saharan Africa	Low income
Cabo Verde	CPV	Sub-Saharan Africa	Lower middle income

Continue of Table A1

Economy	Code	Region	Income group
Cambodia	KHM	East Asia & Pacific	Lower middle income
Cameroon	CMR	Sub-Saharan Africa	Lower middle income
Canada	CAN	North America	High income
Central African Republic	CAF	Sub-Saharan Africa	Low income
Chile	CHL	Latin America & Caribbean	High income
China	CHN	East Asia & Pacific	Upper middle income
Colombia	COL	Latin America & Caribbean	Upper middle income
Congo, Rep.	COG	Sub-Saharan Africa	Lower middle income
Costa Rica	CRI	Latin America & Caribbean	Upper middle income
Côte d'Ivoire	CIV	Sub-Saharan Africa	Lower middle income
Croatia	HRV	Europe & Central Asia	Upper middle income
Czech Republic	CZE	Europe & Central Asia	High income
Denmark	DNK	Europe & Central Asia	High income
Ecuador	ECU	Latin America & Caribbean	Upper middle income
Egypt, Arab Rep.	EGY	Middle East & North Africa	Lower middle income
El Salvador	SLV	Latin America & Caribbean	Lower middle income
Eritrea	ERI	Sub-Saharan Africa	Low income
Estonia	EST	Europe & Central Asia	High income
Ethiopia	ETH	Sub-Saharan Africa	Low income
Fiji	FJI	East Asia & Pacific	Upper middle income
Finland	FIN	Europe & Central Asia	High income
France	FRA	Europe & Central Asia	High income
Gabon	GAB	Sub-Saharan Africa	Upper middle income
Gambia, The	GMB	Sub-Saharan Africa	Low income
Georgia	GEO	Europe & Central Asia	Lower middle income
Germany	DEU	Europe & Central Asia	High income
Ghana	GHA	Sub-Saharan Africa	Lower middle income
Greece	GRC	Europe & Central Asia	High income
Guatemala	GTM	Latin America & Caribbean	Lower middle income
Haiti	HTI	Latin America & Caribbean	Low income
Honduras	HND	Latin America & Caribbean	Lower middle income
Hungary	HUN	Europe & Central Asia	High income
India	IND	South Asia	Lower middle income
Indonesia	IDN	East Asia & Pacific	Lower middle income
Iran, Islamic Rep.	IRN	Middle East & North Africa	Upper middle income
Iraq	IRQ	Middle East & North Africa	Upper middle income
Ireland	IRL	Europe & Central Asia	High income
Italy	ITA	Europe & Central Asia	High income
Jamaica	JAM	Latin America & Caribbean	Upper middle income
Japan	JPN	East Asia & Pacific	High income
Jordan	JOR	Middle East & North Africa	Lower middle income

Continue of Table A1

Economy	Code	Region	Income group
Kazakhstan	KAZ	Europe & Central Asia	Upper middle income
Kenya	KEN	Sub-Saharan Africa	Lower middle income
Korea, Rep.	KOR	East Asia & Pacific	High income
Kuwait	KWT	Middle East & North Africa	High income
Kyrgyz Republic	KGZ	Europe & Central Asia	Lower middle income
Lao PDR	LAO	East Asia & Pacific	Lower middle income
Latvia	LVA	Europe & Central Asia	High income
Lebanon	LBN	Middle East & North Africa	Upper middle income
Libya	LBY	Middle East & North Africa	Upper middle income
Lithuania	LTU	Europe & Central Asia	High income
Macedonia, FYR	MKD	Europe & Central Asia	Upper middle income
Madagascar	MDG	Sub-Saharan Africa	Low income
Malawi	MWI	Sub-Saharan Africa	Low income
Malaysia	MYS	East Asia & Pacific	Upper middle income
Maldives	MDV	South Asia	Upper middle income
Mauritius	MUS	Sub-Saharan Africa	Upper middle income
Mexico	MEX	Latin America & Caribbean	Upper middle income
Moldova	MDA	Europe & Central Asia	Lower middle income
Mongolia	MNG	East Asia & Pacific	Lower middle income
Montenegro	MNE	Europe & Central Asia	Upper middle income
Morocco	MAR	Middle East & North Africa	Lower middle income
Mozambique	MOZ	Sub-Saharan Africa	Low income
Myanmar	MMR	East Asia & Pacific	Lower middle income
Namibia	NAM	Sub-Saharan Africa	Upper middle income
Nepal	NPL	South Asia	Low income
Netherlands	NLD	Europe & Central Asia	High income
New Zealand	NZL	East Asia & Pacific	High income
Nicaragua	NIC	Latin America & Caribbean	Lower middle income
Niger	NER	Sub-Saharan Africa	Low income
Nigeria	NGA	Sub-Saharan Africa	Lower middle income
Norway	NOR	Europe & Central Asia	High income
Pakistan	PAK	South Asia	Lower middle income
Panama	PAN	Latin America & Caribbean	Upper middle income
Papua New Guinea	PNG	East Asia & Pacific	Lower middle income
Paraguay	PRY	Latin America & Caribbean	Upper middle income
Peru	PER	Latin America & Caribbean	Upper middle income
Philippines	PHL	East Asia & Pacific	Lower middle income
Poland	POL	Europe & Central Asia	High income
Portugal	PRT	Europe & Central Asia	High income
Romania	ROU	Europe & Central Asia	Upper middle income
Russian Federation	RUS	Europe & Central Asia	Upper middle income

End of Table A1

Economy	Code	Region	Income group
Rwanda	RWA	Sub-Saharan Africa	Low income
Saudi Arabia	SAU	Middle East & North Africa	High income
Senegal	SEN	Sub-Saharan Africa	Low income
Serbia	SRB	Europe & Central Asia	Upper middle income
Slovak Republic	SVK	Europe & Central Asia	High income
Slovenia	SVN	Europe & Central Asia	High income
South Africa	ZAF	Sub-Saharan Africa	Upper middle income
Spain	ESP	Europe & Central Asia	High income
St. Lucia	LCA	Latin America & Caribbean	Upper middle income
Suriname	SUR	Latin America & Caribbean	Upper middle income
Swaziland	SWZ	Sub-Saharan Africa	Lower middle income
Sweden	SWE	Europe & Central Asia	High income
Switzerland	CHE	Europe & Central Asia	High income
Syrian Arab Republic	SYR	Middle East & North Africa	Lower middle income
Tajikistan	TJK	Europe & Central Asia	Lower middle income
Tanzania	TZA	Sub-Saharan Africa	Low income
Thailand	THA	East Asia & Pacific	Upper middle income
Tonga	TON	East Asia & Pacific	Upper middle income
Trinidad and Tobago	TTO	Latin America & Caribbean	High income
Tunisia	TUN	Middle East & North Africa	Lower middle income
Turkey	TUR	Europe & Central Asia	Upper middle income
Uganda	UGA	Sub-Saharan Africa	Low income
Ukraine	UKR	Europe & Central Asia	Lower middle income
United Kingdom	GBR	Europe & Central Asia	High income
United States	USA	North America	High income
Uruguay	URY	Latin America & Caribbean	High income
Uzbekistan	UZB	Europe & Central Asia	Lower middle income
Vietnam	VNM	East Asia & Pacific	Lower middle income
Yemen, Rep.	YEM	Middle East & North Africa	Lower middle income
Zambia	ZMB	Sub-Saharan Africa	Lower middle income
Zimbabwe	ZWE	Sub-Saharan Africa	Low income

B. Evaluation of potential alternative measures

Digital innovation

Potential alternative measures include Research and Development (R&D) Expenditure (% of GDP), which reflects the financial investment in innovation activities; Patent Applications per Capita, indicating the output of innovation activities in terms of new inventions; and the Global Innovation Index (GII), a composite index that ranks countries based on various innovation inputs and outputs. However, these alternatives have limitations. R&D expenditure does not account for the efficiency or outcomes of the investment and may not directly result in successful innovations. Patent applications may not fully capture innovation activities due to varying patenting behaviors across countries and industries, and not all innovations are patented. The GII, while comprehensive, includes broader dimensions beyond digital innovation, potentially diluting the focus on digital aspects. Therefore, our chosen indicators provide a more direct and practical measure of digital innovation's theoretical, commercial, and economic dimensions, making them a scientifically and rationally sound choice for this study.

Digital inclusion

Other alternative measurement indicators include the quality of internet access, affordability, and digital skills (Alhassan & Adam, 2021; Sharp, 2024). These alternative methods place greater emphasis on the multidimensional characteristics of digital inclusion. However, these alternatives face a series of limitations, particularly regarding data consistency and completeness across countries. Many countries lack comprehensive or standardized statistical data in the ICT field, which reduces data comparability. In contrast, the Information Technology Development Index (IDI) provides relatively complete and easily accessible large-sample data across years, making it more scientific and reliable for measuring digital inclusion.

Digital industry

Potential alternative measures include the Value Added of the ICT Sector (% of GDP), which provides a direct measure of the sector's economic contribution; Employment in the ICT Sector (% of total employment), indicating the sector's role in job creation; and Digital Economy Indices, which offer comprehensive analyses of digital economy trends. However, these alternatives face limitations. Data on value added and employment in the ICT sector may be unavailable or inconsistent across countries, reducing comparability. Digital economy indices may not provide consistent data for all countries in our sample. Our chosen trade-based indicators are widely available and comparable across countries, making them a scientifically and rationally sound choice for measuring the digital industry's development level.

Digital finance

Potential alternative measures include the Global Findex Digital Payments Indicators, which have a specific focus on digital financial transactions; Mobile Money Account Ownership (% ages 15+), a direct measure of mobile financial services adoption; and the Digital Financial Services Adoption Rate, which measures the overall adoption of digital finance. The limitations of these alternatives include limited data availability or coverage, as the Global Findex is updated every three years and may not capture all aspects of digital finance. Focusing solely on mobile money accounts or digital payments may overlook other forms of digital finance.

Our selected indicators provide a comprehensive view of both access and usage, supporting the scientific and rational choice of our measurement method.

Digital governance

Potential alternative measures include the World Bank's Digital Adoption Index (Government component), which focuses on government adoption of digital technologies; the Open Data Barometer, which assesses government openness and transparency through data availability; and the E-Government Survey Detailed Indicators, which provide granular data on e-government initiatives. These alternatives have drawbacks such as limited coverage, infrequent updates, or a narrow focus on specific aspects like open data. Our chosen indexes from the EGDI are globally recognized, consistently updated, and specifically address the provision of digital services and citizen engagement. This makes our measurement method scientifically and rationally appropriate for the study.

Economic level

Potential alternative measures include Gross National Income (GNI) per capita, the Human Development Index (HDI), and Median Household Income. However, each of these alternatives has limitations. GNI per capita, while comprehensive, may introduce inconsistencies due to varying income sources and remittances across countries, potentially complicating cross-country comparisons. The HDI includes non-economic factors, which could confound analyses that aim to isolate economic influences on regional disparities. Additionally, Median Household Income data may be limited or inconsistently reported across different countries, reducing its comparability and reliability for a global analysis. Therefore, per capita GDP is chosen as it provides a widely recognized, straightforward, and comparable measure of economic level.

Governance capacity

Potential alternative measures include the Corruption Perceptions Index (CPI), which focuses on perceived levels of public sector corruption; the Ease of Doing Business Index, which measures regulatory quality and efficiency; and the Institutional Profiles Database (IPD), which covers institutional characteristics across countries. The limitations of these alternatives include a narrow focus (CPI on corruption only), discontinuation or methodological concerns (Ease of Doing Business Index was discontinued in 2021 due to data irregularities), and limited updates or coverage (IPD). The WGI provides a comprehensive and widely used assessment of governance quality, making it a scientifically and rationally appropriate choice for our study.

Degree of openness

Potential alternative measures include the Trade Openness Ratio ((Exports + Imports)/GDP), a simple measure of trade openness; the Chinn-Ito Financial Openness Index, which measures capital account openness; and the Heritage Foundation's Trade Freedom Index, which measures the absence of trade barriers. These alternatives have limitations such as focusing solely on trade or financial aspects, not capturing the full scope of economic globalization, or being influenced by country size and economic structure. The KOF Index provides a comprehensive and comparable measure of economic openness, supporting the scientific and rational choice of our measurement method.

C. Average results of Necessary Condition Analysis

C presents the average results of the Necessary Condition Analysis (NCA) for both the reduction and expansion of regional income disparities. The table lists each condition variable along with its effect size and p-value for both outcomes.

For the reduction of regional income disparities, none of the individual condition variables show effect sizes exceeding the threshold of 0.1 with significant p-values ($p < 0.05$). This indicates that no single digitalization factor or contextual condition alone is a necessary condition for reducing disparities. The largest effect size observed is 0.06 for Digital Innovation, but its p-value is 0.097, which is above the conventional significance level.

For the expansion of regional income disparities, similarly, none of the variables exhibit significant effect sizes or p-values, suggesting that no single condition is necessary for increasing disparities.

These findings support the conclusion that individual conditions are not necessary on their own to affect regional income disparities, reinforcing the importance of considering combinations of factors (configurations) in the analysis.

Table C1. Average results of Necessary Condition Analysis

	Expansion of regional income disparities		Expansion of regional income disparities	
	Effect size	P-value	Effect size	P-value
Digital innovation	0.06	0.097	0.01	0.598
Digital inclusion	0.03	0.287	0.01	0.821
Digital industry	0	0.915	0	0.844
Digital finance	0.02	0.361	0.01	0.734
Digital governance	0	0.238	0	0.816
Economic level	0.01	0.482	0	0.788
Governance level	0.03	0.289	0.01	0.773
Degree of openness	0.05	0.172	0	0.868

D. Analysis of necessary conditions across different years

D provides an annual analysis of the necessity of conditions for both reducing and expanding regional income disparities from 2012 to 2021. The tables display the effect sizes and p-values for each condition variable in each year.

1. Analysis for reducing regional income disparities:

The annual analysis reveals that starting from 2016, certain digitalization variables – specifically digital industry, digital finance, digital governance, and degree of openness – show increasing effect sizes with p-values approaching significance ($p < 0.1$). For instance, in 2016, Digital Industry has an effect size of 0.13 with a p-value of 0.018, indicating its growing importance as a necessary condition for reducing disparities. This trend continues in subsequent years, highlighting the strengthening role of these digital factors over time.

2. Analysis for expanding regional income disparities:

For the expansion of disparities, none of the condition variables demonstrate significant effect sizes or p-values in any year. This suggests that no single digitalization or contextual factor is a necessary condition for increasing regional income disparities during the study period.

These findings emphasize the dynamic nature of digitalization's impact on regional income disparities and underscore the increasing importance of certain digital factors in reducing disparities since 2016.

Table D1. Analysis of necessary conditions for reducing regional income disparities

	Digital innovation effect size	Digital innovation P-value	Digital inclusion effect size	Digital inclusion P-value	Digital industry effect size	Digital industry P-value	Digital finance effect size	Digital finance P-value	Digital governance effect size	Digital governance P-value	Economic level effect size	Economic level P-value	Governance level effect size	Governance level P-value	Degree of openness effect size	Degree of openness P-value
2012	0.06	0.097	0.03	0.287	0	0.915	0.02	0.361	0	0.238	0.01	0.482	0.03	0.289	0.05	0.172
2013	0.01	0.598	0.01	0.821	0	0.844	0.01	0.734	0	0.816	0	0.788	0.01	0.773	0	0.868
2014	0.01	0.661	0.03	0.371	0	0.749	0.03	0.311	0	0.8	0.01	0.55	0.01	0.702	0.02	0.591
2015	0.03	0.325	0.04	0.322	0	0.719	0.01	0.623	0.06	0.163	0.01	0.548	0.01	0.727	0.01	0.627
2016	0.04	0.3	0.04	0.342	0.13	0.018	0.08	0.122	0.14	0.012	0.01	0.557	0.01	0.713	0.09	0.081
2017	0	0.773	0.04	0.319	0.16	0.007	0.07	0.163	0.18	0.01	0.01	0.536	0.01	0.687	0.09	0.09
2018	0.05	0.211	0.05	0.294	0.01	0.636	0.09	0.121	0.11	0.068	0.01	0.529	0.01	0.69	0.1	0.091
2019	0.04	0.265	0.05	0.282	0.18	0.004	0.08	0.159	0.14	0.044	0.01	0.512	0.05	0.237	0.07	0.159
2020	0.03	0.334	0.05	0.304	0.23	0.001	0.08	0.156	0.12	0.069	0.01	0.522	0.06	0.21	0.07	0.197
2021	0.05	0.245	0.04	0.327	0.09	0.102	0.03	0.426	0.18	0.011	0.01	0.509	0.06	0.199	0.11	0.053

Table D2. Analysis of necessary conditions for expanding regional income disparities

	Digital innovation effect size	Digital innovation P-value	Digital inclusion effect size	Digital inclusion P-value	Digital industry effect size	Digital industry P-value	Digital finance effect size	Digital finance P-value	Digital governance effect size	Digital governance P-value	Economic level effect size	Economic level P-value	Governance level effect size	Governance level P-value	Degree of openness effect size	Degree of openness P-value
2012	0.01	0.598	0.01	0.821	0	0.844	0.01	0.734	0	0.816	0	0.788	0.01	0.773	0	0.868
2013	0.01	0.686	0	0.885	0	1	0.02	0.503	0	0.854	0.03	0.511	0.05	0.44	0.11	0.131
2014	0.02	0.686	0.01	0.894	0.01	0.748	0.03	0.462	0	0.91	0.02	0.608	0.05	0.448	0.11	0.15
2015	0.01	0.81	0.01	0.881	0.01	0.725	0.06	0.32	0	0.994	0.02	0.625	0.04	0.563	0.07	0.322
2016	0.01	0.872	0.01	0.9	0	0.963	0.02	0.588	0	0.982	0.01	0.655	0.05	0.458	0.03	0.582
2017	0.01	0.739	0.01	0.921	0	1	0.03	0.582	0	0.928	0.02	0.631	0.05	0.481	0.02	0.667
2018	0.02	0.611	0	0.932	0	0.983	0.01	0.9	0.01	0.927	0	0.864	0.02	0.719	0	0.93
2019	0.03	0.518	0.01	0.933	0	0.982	0.01	0.906	0.01	0.934	0	0.863	0.02	0.829	0.01	0.89
2020	0.03	0.543	0	0.937	0	0.991	0.01	0.895	0.01	0.958	0	0.868	0.02	0.82	0.01	0.899
2021	0.02	0.598	0	0.935	0	0.983	0.01	0.841	0	0.967	0	0.856	0.02	0.807	0.01	0.899

E. Between consistency analysis results

E presents the between consistency analysis results for each configuration over the years 2012 to 2021. Between consistency reflects how consistently a configuration explains the outcome (reduction or expansion of regional income disparities) across different years.

For configurations reducing regional income disparities: The configurations (H1, H2, H3a, H3b, H4) exhibit high between consistency values, generally above 0.9 throughout the period. This indicates strong and consistent explanatory power of these configurations over time. Configurations involving comprehensive digital transformation (H1 and H3) show a slight declining trend in between consistency, suggesting that while they remain effective, their explanatory power may be gradually decreasing over time. Configuration H4 shows an increasing trend in between consistency, indicating that focused digital strategies based on openness and economic foundation are becoming more effective in reducing disparities.

For configurations expanding regional income disparities: The configurations (NH1, NH2, NH3, NH4) have between consistency values ranging from 0.75 to 0.85, exhibiting a progressive strengthening tendency across the temporal dimension. This suggests that the absence of digital transformation is increasingly contributing to the expansion of regional income disparities. These results highlight the evolving effectiveness of different digitalization configurations over time and underscore the growing importance of certain strategies in addressing regional income disparities.

Table E1. Between consistency analysis results for reducing regional income disparities

	H1	H2	H3a	H3b	H4	NH1	NH2	NH3	NH4
2012	0.941	0.923	0.954	0.954	0.933	0.857	0.804	0.808	0.807
2013	0.945	0.922	0.957	0.953	0.934	0.826	0.810	0.808	0.819
2014	0.942	0.927	0.950	0.946	0.936	0.831	0.767	0.809	0.835
2015	0.930	0.924	0.945	0.942	0.932	0.821	0.776	0.821	0.824
2016	0.928	0.930	0.940	0.94	0.937	0.811	0.782	0.817	0.818
2017	0.928	0.921	0.946	0.944	0.947	0.800	0.782	0.815	0.825
2018	0.924	0.925	0.941	0.947	0.952	0.807	0.798	0.820	0.826
2019	0.920	0.926	0.934	0.939	0.955	0.821	0.810	0.839	0.845
2020	0.923	0.931	0.936	0.934	0.965	0.807	0.825	0.841	0.841
2021	0.925	0.932	0.931	0.93	0.97	0.789	0.824	0.848	0.818

F. Within consistency analysis results

F presents the within consistency analysis results, which assess how effectively each configuration explains the outcome for individual economies. Within consistency reflects the explanatory power of a configuration for different cases, with values closer to 1 indicating stronger explanatory power.

Our analysis of inequality-reducing configurational patterns reveals robust descriptive capability across an overwhelming proportion of examined nations. This suggests that the identified configurations are effective across diverse contexts in explaining the reduction of

regional income disparities. However, a few economies, such as the United States, China, Russia, and Turkey, exhibit lower within consistency values in some configurations. These economies often have large geographic areas, diverse economic conditions, or significant differences between per capita and absolute levels of digital development indicators. Such characteristics may mean that additional factors, not captured by the current configurations, influence regional income disparities in these countries.

In contrast, for the configurations that are associated with the expansion of regional income disparities, the within consistency analysis reveals a relatively larger number of economies with limited explanatory power. These cases are concentrated primarily in emerging economies, suggesting that additional elements beyond our digital and contextual variables likely influence territorial economic divergence. The similar within consistency performance across different configurations for expanding disparities suggests that other unmeasured variables or unique national circumstances may be at play, warranting further investigation.

Table F1. Within consistency analysis results for reducing regional income disparities

code	H1	H2	H3a	H3b	H4
AFG	1	1	1	1	1
ALB	1	1	1	1	1
ARG	1	1	1	1	1
ARM	1	1	1	1	1
AUS	1	1	1	1	1
AUT	1	1	1	1	1
BDI	1	1	1	1	1
BEL	1	1	1	1	1
BGD	1	1	1	1	1
BIH	1	1	1	1	1
BLR	1	1	1	1	1
BLZ	1	1	1	1	1
BOL	1	1	1	1	1
BRA	1	1	1	1	1
BRB	1	1	1	1	1
BWA	1	1	1	1	1
CAF	1	1	1	1	1
CHE	1	1	1	1	1
CHL	1	1	1	1	1
CIV	1	1	1	1	1
CMR	1	1	1	1	1
COL	1	1	1	1	1
CPV	1	1	1	1	1
CRI	1	1	1	1	1
DEU	1	1	1	1	1
DNK	1	1	1	1	1

code	H1	H2	H3a	H3b	H4
DZA	1	1	1	1	1
ECU	1	1	1	1	1
EGY	1	1	1	1	1
ESP	1	1	1	1	1
FIN	1	1	1	1	1
FJI	1	1	1	1	1
FRA	1	1	1	1	1
GAB	1	1	1	1	1
GBR	1	1	1	1	1
GEO	1	1	1	1	1
GHA	1	1	1	1	1
GMB	1	1	1	1	1
GRC	1	1	1	1	1
GTM	1	1	1	1	1
HND	1	1	1	1	1
HRV	1	1	1	1	1
HTI	1	1	1	1	1
HUN	1	1	1	1	1
IDN	1	1	1	1	1
IND	1	1	1	1	1
IRL	1	1	1	1	1
IRN	1	1	1	1	1
IRQ	1	1	1	1	1
JAM	1	1	1	1	1
JOR	1	1	1	1	1
JPN	1	1	1	1	1

End of Table F1

code	H1	H2	H3a	H3b	H4
KAZ	1	1	1	1	1
KGZ	1	1	1	1	1
KHM	1	1	1	1	1
KOR	1	1	1	1	1
KWT	1	1	1	1	1
LAO	1	1	1	1	1
LBY	1	1	1	1	1
LCA	1	1	1	1	1
MAR	1	1	1	1	1
MDG	1	1	1	1	1
MDV	1	1	1	1	1
MEX	1	1	1	1	1
MKD	1	1	1	1	1
MMR	1	1	1	1	1
MNE	1	1	1	1	1
MNG	1	1	1	1	1
MOZ	1	1	1	1	1
MUS	1	1	1	1	1
MWI	1	1	1	1	1
MYS	1	1	1	1	1
NER	1	1	1	1	1
NGA	1	1	1	1	1
NIC	1	1	1	1	1
NLD	1	1	1	1	1
NOR	1	1	1	1	1
NPL	1	1	1	1	1
NZL	1	1	1	1	1
PAK	1	1	1	1	1
PHL	1	1	1	1	1
POL	1	1	1	1	1
PRT	1	1	1	1	1
PRY	1	1	1	1	1
RWA	1	1	1	1	1
SAU	1	1	1	1	1
SEN	1	1	1	1	1
SLV	1	1	1	1	1
SRB	1	1	1	1	1
SVN	1	1	1	1	1
SWE	1	1	1	1	1
SWZ	1	1	1	1	1
SYR	1	1	1	1	1

code	H1	H2	H3a	H3b	H4
THA	1	1	1	1	1
TJK	1	1	1	1	1
TON	1	1	1	1	1
TTO	1	1	1	1	1
TUN	1	1	1	1	1
TZA	1	1	1	1	1
UGA	1	1	1	1	1
UKR	1	1	1	1	1
URY	1	1	1	1	1
VNM	1	1	1	1	1
YEM	1	1	1	1	1
ZAF	1	1	1	1	1
ITA	0.981	1	1	1	1
CAN	0.952	1	1	1	1
LTU	1	0.921	1	1	1
ERI	0.992	0.98	0.993	0.993	0.931
LBN	1	1	0.987	0.987	0.903
AZE	1	1	1	0.83	1
MDA	1	1	0.791	1	1
UZB	1	1	0.869	0.865	1
PER	0.683	1	1	1	1
ZWE	0.984	0.959	0.949	0.808	0.983
EST	1	0.676	1	1	1
USA	0.671	1	1	1	1
SUR	1	0.655	1	1	1
TUR	1	0.893	1	0.76	1
KEN	0.891	0.965	0.864	0.965	0.965
CZE	0.888	1	0.903	0.903	0.903
CHN	0.431	1	0.982	0.982	0.98
ZMB	0.865	0.846	0.866	0.869	0.841
COG	0.906	0.787	0.906	0.906	0.669
RUS	0.818	0.894	0.686	0.599	0.991
LVA	1	0.348	0.869	0.849	0.88
NAM	0.835	0.223	0.927	0.642	0.924
BGR	0.974	0.5	0.583	0.576	0.721
AGO	0.586	0.586	0.616	0.616	0.616
ROU	0.164	0.373	0.224	0.224	0.231
ETH	0.148	0.152	0.152	0.152	0.152
SVK	0.177	0.19	0.12	0.12	0.133
PAN	0.134	0.035	0.189	0.189	0.189
PNG	0.075	0.057	0.075	0.06	0.072

Table F2. Within consistency analysis results for expanding regional income disparities

code	NH1	NH2	NH3	NH4
AGO	1	1	1	1
AUS	1	1	1	1
AUT	1	1	1	1
AZE	1	1	1	1
BEL	1	1	1	1
BGR	1	1	1	1
BLZ	1	1	1	1
BWA	1	1	1	1
CAF	1	1	1	1
CAN	1	1	1	1
CHE	1	1	1	1
CHN	1	1	1	1
CMR	1	1	1	1
COG	1	1	1	1
COL	1	1	1	1
CZE	1	1	1	1
DEU	1	1	1	1
DNK	1	1	1	1
ERI	1	1	1	1
ESP	1	1	1	1
EST	1	1	1	1
ETH	1	1	1	1
FIN	1	1	1	1
FJI	1	1	1	1
FRA	1	1	1	1
GAB	1	1	1	1
GBR	1	1	1	1
GHA	1	1	1	1
GMB	1	1	1	1
GRC	1	1	1	1
GTM	1	1	1	1
HRV	1	1	1	1
HTI	1	1	1	1
HUN	1	1	1	1
IND	1	1	1	1
IRL	1	1	1	1
ITA	1	1	1	1
JPN	1	1	1	1
KEN	1	1	1	1
KHM	1	1	1	1
KOR	1	1	1	1

code	NH1	NH2	NH3	NH4
LBN	1	1	1	1
LTU	1	1	1	1
LVA	1	1	1	1
MDA	1	1	1	1
MNG	1	1	1	1
MOZ	1	1	1	1
MUS	1	1	1	1
MYS	1	1	1	1
NAM	1	1	1	1
NIC	1	1	1	1
NLD	1	1	1	1
NOR	1	1	1	1
NZL	1	1	1	1
PAK	1	1	1	1
PAN	1	1	1	1
PER	1	1	1	1
PNG	1	1	1	1
POL	1	1	1	1
PRT	1	1	1	1
ROU	1	1	1	1
RUS	1	1	1	1
RWA	1	1	1	1
SEN	1	1	1	1
SUR	1	1	1	1
SVK	1	1	1	1
SVN	1	1	1	1
SWE	1	1	1	1
TJK	1	1	1	1
TZA	1	1	1	1
UGA	1	1	1	1
USA	1	1	1	1
UZB	1	1	1	1
YEM	1	1	1	1
ZAF	1	1	1	1
ZMB	1	1	1	1
ZWE	1	1	1	1
GEO	1	0.997	1	1
NGA	1	1	1	0.997
CIV	1	1	1	0.993
PHL	1	1	1	0.988
MDG	1	0.995	0.989	1

End of Table F2

code	NH1	NH2	NH3	NH4
BOL	0.978	1	1	1
HND	1	0.973	1	1
BRA	0.98	1	1	0.975
TON	1	0.997	0.956	0.995
JAM	0.979	1	0.946	1
LAO	1	0.92	1	1
BGD	1	0.919	1	1
MEX	0.917	1	1	1
TUR	0.966	1	0.903	0.856
MMR	1	0.676	1	1
IDN	0.834	1	0.982	0.815
NER	1	0.56	1	1
CHL	0.814	0.996	0.714	0.959
ECU	0.691	0.739	0.969	1
AFG	0.786	0.596	1	1
NPL	1	0.393	1	0.953
IRN	0.795	0.758	0.93	0.741
IRQ	0.503	0.902	0.999	0.778
MDV	0.615	1	0.527	1
VNM	0.802	0.803	0.882	0.649
PRY	0.702	0.659	0.857	0.8
KGZ	0.43	0.911	0.666	0.738
MWI	0.981	0.421	0.615	0.718
BDI	0.66	0.445	0.964	0.661
LBY	1	0.221	1	0.469
SWZ	0.63	0.616	0.525	0.906

code	NH1	NH2	NH3	NH4
SAU	0.505	0.872	0.614	0.604
MNE	0.77	0.222	0.77	0.758
BLR	0.647	0.594	0.664	0.594
KAZ	0.502	0.639	0.66	0.639
CPV	0.676	0.598	0.401	0.706
DZA	0.656	0.436	0.29	0.917
BRB	0.637	0.522	0.614	0.522
SYR	0.499	0.484	1	0.304
SLV	0.444	0.571	0.553	0.717
UKR	0.621	0.335	0.623	0.623
KWT	0.574	0.319	0.574	0.574
ARM	0.41	0.378	0.434	0.817
THA	0.413	0.77	0.42	0.42
TTO	0.306	1	0.283	0.283
TUN	0.256	0.645	0.458	0.414
URY	0.386	0.45	0.385	0.45
LCA	0.314	0.922	0.161	0.236
ALB	0.173	0.583	0.181	0.607
MKD	0.336	0.274	0.316	0.316
SRB	0.299	0.298	0.3	0.3
CRI	0.286	0.296	0.248	0.296
JOR	0.311	0.132	0.311	0.267
ARG	0.226	0.256	0.256	0.254
BIH	0.284	0.312	0.193	0.196
EGY	0.256	0.164	0.347	0.15
MAR	0.219	0.23	0.271	0.182

G. Cases affiliated with each configuration

G provides detailed information on the economies affiliated with each configuration identified in the sufficiency analysis.

Table G1. Cases affiliated with each configuration

Configurations	Affiliated cases
H1	MYS2013, NER2019, SWE2019, SWE2020, SWE2021, SWZ2011, SWZ2012, SWZ2013, SWZ2014, SWZ2015, ARG2014, ARG2015, ARG2016, ARG2017, BWA2013, BWA2014, BWA2015, BWA2016, BWA2017, COG2018, COG2019, COG2020, COG2021, COL2013, IRL2015, IRL2016, IRL2017, IRL2018, IRL2019, IRL2020, IRL2021, IRN2011, IRN2012, IRN2013, JOR2014, JOR2015, JOR2016, JOR2017, JOR2019, NPL2021, NZL2013, NZL2015, SWZ2016, SWZ2017, SWZ2018, SWZ2019, SWZ2020, SWZ2021, SYR2011, SYR2012, SYR2013, SYR2014
H2	ESP2020, KGZ2018, KGZ2019, KGZ2020, KGZ2021, KHM2011, KHM2012, KHM2014, MDG2014, MDG2015, MDG2016, POL2015, POL2016, POL2017, CAN2012, CAN2013, CAN2014, CAN2015, CAN2019, MDG2017, MDG2018, MDG2019, MDG2020, MDG2021, MDV2011, MDV2012, JOR2020, JOR2021, JPN2011, LVA2017, LVA2018, LVA2019, NAM2017, NAM2018, JPN2012, JPN2014, JPN2017, LVA2020, LVA2021, 2011-03-01, 2012-03-01, 2013-03-01, 2014-03-01, 2015-03-01, MWI2016, MWI2017, MWI2018, MWI2019, MWI2020, MWI2021, MYS2011, MYS2012, NAM2019, NAM2020, NAM2021
H3	LAO2019, LAO2020, LAO2021, SWE2011, SWE2012, SWE2013, SWE2014, SWE2015, SWE2016, BIH2014, BIH2015, BIH2016, BIH2017, BIH2018, IRN2015, IRN2019, IRN2020, IRN2021, IRQ2011, PAN2016, PAN2017, PAN2018, PAN2019, PAN2020, PAN2021, PER2011, RWA2019, RWA2020, RWA2021, SAU2011, SAU2012, SAU2013, BIH2014, BIH2015, BIH2016, BIH2017, BIH2018, IRN2015, IRN2019, IRN2020, IRN2021, IRQ2011
H4	KAZ2018, KAZ2019, KAZ2020, KAZ2021, KEN2011, KEN2014
NH1	BLZ2012, BLZ2013, EGY2021, ITA2021, SVK2014, SVK2015, SVK2016, SVK2017, SVK2018, SVN2013, SVN2014, SVN2015, SVN2016, SVN2017, ERI2011, ERI2012, MNE2016, MNE2017, MNE2018, SRB2016, SYR2019, SYR2020
NH2	AFG2013, AFG2016, AFG2017, AZE2017, AZE2018, BEL2012, BEL2013, BEL2014, BEL2015, BEL2016, CHL2016, CHL2018, CHL2019, CHL2020, CHL2021, CHN2011, CHN2012, CHN2013, CHN2014, CHN2015, CHN2016, CHN2017, DNK2019, DNK2020, DNK2021, DZA2011, DZA2012, DZA2013, DZA2014, DZA2015, DZA2016, DZA2017, GBR2019, GBR2020, GBR2021, IRQ2013, IRQ2014, IRQ2015, JPN2019, JPN2020, JPN2021, KAZ2011, KAZ2012, KAZ2013, KAZ2014, KAZ2015, KAZ2016, KAZ2017, LTU2018, LTU2019, LTU2020, LTU2021, LVA2011, LVA2012, LVA2013, LVA2014, LVA2015, LVA2016, MDV2014, MDV2015, MDV2017, MDV2018, MDV2019, MDV2020, MEX2011, MMR2012, MMR2013, MMR2014, MMR2015, MMR2016, MMR2017, MMR2018, MMR2019, MUS2016, MUS2017, MUS2018, MUS2019, MUS2020, MUS2021, MWI2014, MYS2016, MYS2017, MYS2019, MYS2020, PER2013, ROU2017, ROU2019, RWA2013, TON2011, AFG2021, AGO2011, AGO2012, AGO2013, AGO2015, AGO2016, AGO2017, AGO2018, AGO2019, CIV2015, GEO2016, GEO2017, GEO2018, GEO2019, GEO2020, GEO2021, GHA2011, GHA2014, MNE2021, MNG2015, MNG2016
NH3	AGO2020, ALB2011, MKD2011, MKD2012, NER2012, PAK2017, PAK2020, PHL2012, TTO2012, TTO2013
NH4	BRB2018, BRB2019, BRB2020, BRB2021, BWA2011, BWA2012, CHL2011, CHL2013, GTM2012, GTM2013, GTM2014, GTM2016, MNE2011, MNE2012, MNE2013, MNE2014, MNE2015, SYR2015, SYR2016, SYR2017, SYR2018, TTO2016, CHL2015, CIV2016, DNK2014, DNK2015, HND2011, HND2012, HND2013, KWT2013, KWT2014, MDV2016, NGA2011, NGA2012, NGA2013

H. Robustness tests: adjusting the inequality measurement of outcome variables

H presents the results of robustness tests conducted by using alternative measures of regional income disparities – the Gini coefficient and the coefficient of variation – as the outcome variable in the sufficiency analysis. These tests aim to assess whether the main conclusions of the study hold true when different inequality indices are applied.

In the sufficiency analysis using the Gini coefficient as the outcome variable, the configurations identified are consistent with those in the main analysis, with the exception of Configuration H4. The configurations maintain high consistency and coverage values, indicating that the factors leading to the reduction of regional income disparities are robust across different measures of inequality. This suggests that the beneficial effects of digitalization configurations on reducing disparities is not sensitive to the specific inequality index used.

Similarly, when the coefficient of variation is used as the outcome variable, the sufficiency analysis yields configurations that are largely consistent with the main findings, with the exception of Configuration H4. This indicates that the main conclusions regarding the effectiveness of certain digitalization strategies in reducing regional income disparities are stable even when alternative measures of inequality are considered.

Table H1. Sufficiency analysis with Gini coefficient as the outcome variable (reduction of regional income disparities)

	H5	H6	H7	H8
Digital innovation	⊗	□		⊗
Digital inclusion	●	□	●	●
Digital industry	●	●	●	⊗
Digital finance	□	●	□	□
Digital governance	●	□	□	⊗
Economic level	□		□	□
Governance level	□	⊗	●	□
Degree of openness		●	⊗	□
Consistency	0.933	0.943	0.929	0.938
PRI	0.756	0.774	0.733	0.757
Raw coverage(covS)	0.243	0.219	0.249	0.235
Unique coverage (covU)	0.018	0.025	0.037	0.068
Overall solution consistency	0.909			
Overall PRI	0.743			
Overall solution coverage	0.387			

Table H2. Sufficiency analysis with coefficient of variation as the outcome variable (reduction of regional income disparities)

	H9	H10	H11	H12
Digital innovation	⊠	□	□	
Digital inclusion	□	□	□	●
Digital industry		●		●
Digital finance	□	●	□	□
Digital governance		□	□	□
Economic level	□		□	□
Governance level	□	⊗	⊠	●
Degree of openness	□	●	□	⊗
Consistency	0.918	0.935	0.934	0.918
PRI	0.758	0.75	0.77	0.709
Raw coverage (covS)	0.316	0.219	0.242	0.248
Unique coverage (covU)	0.086	0.011	0.011	0.05
Overall solution consistency	0.893			
Overall PRI	0.73			
Overall solution coverage	0.416			

I. Robustness tests: adjusting thresholds in sufficiency analysis

I presents the robustness assessment outcomes by modifying critical parameters within the sufficiency analysis procedure, with a focus on altering the minimum case count and consistency level requirements. These adjustments test the stability of the configurations under different analytical conditions.

When the case frequency threshold is increased from 6 to 8, the sufficiency analysis still identifies configurations that are consistent with the main analysis, primarily reflecting Configurations H1, H2, and H3. The consistency and coverage values remain high, indicating that the results are robust to changes in the case frequency threshold. This suggests that the identified configurations are not sensitive to the minimum number of cases required for inclusion, and the conclusions drawn about the impact of digitalization on regional income disparities remain valid.

Similarly, adjusting the consistency threshold to 0.85, which is a stricter requirement than the original threshold, yields configurations that are consistent with those identified in the main analysis. The overall solution consistency and coverage remain strong, demonstrating that the main findings are stable even with more stringent consistency criteria.

Table I1. Adjusting the case frequency threshold to 8 cases in sufficiency analysis (reduction of regional income disparities)

	H13	H14	H15	H16
Digital innovation	⊗	●	●	
Digital inclusion	●	●	●	□
Digital industry		□		□
Digital finance	□	□	□	□
Digital governance		□	□	□
Economic level	●		□	□
Governance level	□	⊗	⊗	□
Degree of openness	□	●	●	⊠
Consistency	0.926	0.942	0.942	0.93
PRI	0.803	0.794	0.813	0.769
Raw coverage (covS)	0.298	0.206	0.228	0.235
Unique coverage (covU)	0.082	0.011	0.01	0.049
Overall solution consistency	0.908			
Overall PRI	0.782			
Overall solution coverage	0.396			

Table I2. Adjusting the inclusion cut-off value to 0.85 cases in sufficiency analysis (reduction of regional income disparities)

	H17	H18	H19	H20	H21
Digital innovation	⊗	●	●		●
Digital inclusion	●	●	●	●	●
Digital industry		□		●	□
Digital finance	□	□	□	□	⊠
Digital governance		□	□	□	⊠
Economic level	●		□	□	□
Governance level	□	⊗	⊗	●	⊗
Degree of openness	□	●	●	⊗	●
Consistency	0.926	0.942	0.942	0.93	0.945
PRI	0.803	0.794	0.813	0.769	0.763
Raw coverage (covS)	0.298	0.206	0.228	0.235	0.175
Unique coverage (covU)	0.077	0.011	0.01	0.049	0.009
Overall solution consistency	0.907				
Overall PRI	0.783				
Overall solution coverage	0.405				

J. Robustness tests: adjusting the lag periods of condition variables

J presents the results of the sufficiency analysis conducted without lagging the condition variables, testing the sensitivity of the findings to changes in the temporal structure of the data. In the main analysis, a one-period lag was applied to the condition variables to account for potential time delays in the impact of digitalization on regional income disparities. When the sufficiency analysis is performed with non-lagged condition variables, the configurations identified are largely consistent with those in the main study, except for Configuration H4.

Table J1. Sufficiency analysis with non-lagged condition variables (reduction of regional income disparities)

	H22	H23	H24	H25
Digital innovation	⊗		⊗	□
Digital inclusion	●	●	●	□
Digital industry	●	●	⊗	⊠
Digital finance	□	□	□	□
Digital governance	●	□	⊗	□
Economic level	□	□	□	□
Governance level	□	●	□	⊠
Degree of openness		⊗	□	□
Consistency	0.936	0.931	0.936	0.937
PRI	0.791	0.774	0.783	0.775
Raw coverage (covS)	0.231	0.238	0.222	0.202
Unique coverage (covU)	0.023	0.037	0.044	0.019
Overall solution consistency	0.909			
Overall PRI	0.77			
Overall solution coverage	0.363			