After the Shock
Reform, Resilience, and Economic Transformation in MENA
ERF 32nd Annual Conference
June 14-16 | Cairo, Egypt

2026

Does Digital Transformation Reduce Social Inequalities in MENA Countries?

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ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية

Does digital transformation reduce social inequalities in MENA Countries?

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Abstract

Purpose: This study examines the effect of digital transformation on social inequalities in the MENA region separately and then moderated by institutional quality (government effectiveness, rule of law, regulatory quality, and political stability).

Design/methodology/approach: A two-stage least squares regression method was used for a sample of 14 Arab MENA countries observed from 2012 to 2022. Four composite indices of social inequality were constructed using principal component analysis: health and well-being, education and economic participation, economic inequality and social inclusion, and health infrastructure and spending. Digital transformation was measured using five key indicators from the international telecommunication union.

Findings: The results indicate significant positive relationships between digital transformation and the reduction of social inequalities across all dimensions. Furthermore, government effectiveness and political stability moderate this relationship; these institutional dimensions separately amplify the positive impact of digital transformation on inequality reduction. Moreover, rule of law shows no significant moderating effect, while regulatory quality demonstrates weak and inconsistent moderating effects. Splitting our sample according to country-specific features (gulf cooperation council (GCC) countries versus non-GCC countries) confirms our findings and reveals that digital transformation's inequality-reducing effects are stronger in non-GCC countries, where institutional quality moderators become far more significant.

Research limitations/implications: Governments and policymakers in the MENA region have to be aware of the inequality-reducing potential of digital transformation. In addition, they have to prioritize institutional quality improvements, particularly government effectiveness and political stability, when they seek to maximize the social benefits of digital transformation initiatives.

Originality/value: This paper offers an in-depth understanding of the impact of digital transformation on social inequalities. Some recommendations on the importance of strengthening institutional frameworks are highlighted; encouraging governments to invest in both digital infrastructure and institutional capacity building to ensure that digital transformation serves as a tool for equity rather than exclusion in this region.

Introduction

Balancing economic development and reducing inequalities is always a significant concern for countries. In response, many countries have implemented many strategies to ensure this balance. Nowadays one top priority of countries strategy is to reinforce their digital transformation. However, the consequence of such transformation is not obvious. In this line, previous studies have shown that digital transformation has contributed to economic development. However, the effect of digital transformation on inequalities remains not enough studied.

While, recent studies have explored the impact of digital transformation on various forms of inequality—such as income inequality (Baffour et al., 2025), economic inequality (Adam et al., 2025), global inequality (Santos et al., 2022), epistemic justice (Mhlongo & Dlamini, 2022), and social well-being (Kraus, 2024)—these contributions often emphasize economic or macro-level effects. As a result, they overlook the multidimensional nature of social inequalities, which remain a pressing issue globally (Grusky, 2019).

Another limitation of previous studies lies in their limited scope: many focuses only on economic dimensions of inequality and fail to examine broader social outcomes such as access to education, healthcare, and public services.

In addition, existing studies often overlook the mechanisms by which digital transformation influences inequalities. However, countries operate in a complex institutional environment where various institutional factors shape the design, implementation, and consequences of their digital transformation strategies. Institutional quality—covering regulatory quality, government effectiveness, rule of law and control of corruption, and political stability and security—has a direct impact on countries' capacity to formulate and sustain coherent digital transformation initiatives. Therefore, institutional quality may play moderating roles in the relationship between digital transformation and socioeconomic inequalities.

Finally, most of these studies are conducted in China (Li et al., 2023), France (Houngbonon et al., 2021), G20 countries (Yin et al., 2022), or broad categories of developed and developing nations (Nguyen, 2023). This limitation raises concerns about the external validity of findings when applied to other regions, particularly the Arab MENA countries.

These shortcomings have arguably compromised the full understanding of the effects of digital transformation on social inequalities, justifying further scrutiny.

Therefore, this study aims to answer the following research questions:

RQ1.: Does digital transformation contribute to a reduction of social inequalities ??

RQ2.: How does institutional quality affect the relationship between digital transformation and social inequalities?

Thus, this study integrates the capability approach to explore whether digital transformation reduce social inequalities. Additionally, it analyzes the moderating effects of institutional quality within institutional theory.

Therefore, our study examines a sample of 14 Arab MENA countries during the period 2012–2022.

This region presents a compelling case due to its high levels of social inequality and the urgent need for inclusive development strategies. Addressing these disparities is a strategic necessity for achieving long-term economic growth and social stability. In particular, several Arab MENA countries are increasingly affected by disparities in health outcomes, living standards, access to education and employment opportunities, irregular social inclusion, and unequal distribution of infrastructure and public health resources.

This study reveals a negative relationship between digital transformation and social inequalities. Furthermore, the analysis shows that the inequality-reducing effect of digital transformation is strengthened in contexts of higher institutional quality.

Specifically, this research offers multiple valuable added values. *First*, it expands the analysis of digital transformation impacts beyond the commonly studied outcomes of income inequality, economic inequality, and global inequality by focusing on the broader issue of multidimensional social inequalities. This is an important dimension that has received less attention, despite its significant consequences for social cohesion, sustainable development, and inclusive growth. *Second*, the study provides much-needed evidence on the social impacts of digital transformation in a non-Western, developing context—the Arab MENA countries—which have distinct socioeconomic, institutional, and technological characteristics compared to more developed regions. *Third*, from multiple institutional logics, this research explores the moderating factors influencing the relationship digital transformation and social inequalities.

The rest of the paper is structured as follows in the next section, we develop our theoretical framework and hypotheses. The third section describes our data, defines our variables, and presents our econometric approach. In the fourth section, we discuss our results, and the final section concludes the paper.

2. Theoretical framework

2.1. The impact of digital transformation on social inequalities

The capability approach (Sen, 1999 ; Nussbaum, 2011) analyze social inequality. This theory shifts the focus from mere resources or formal rights to the substantive freedoms that individuals possess to lead lives they value. This approach distinguishes between functionings, the actual states of being and doing that constitute well-being (e.g., being healthy, educated, or participating in community life) and capabilities, which represent the substantive freedoms or real opportunities to achieve these functionings (Martins, 2007; Spatscheck, 2012; Kimhur, 2020).

From this perspective, social inequality emerges when individuals or groups lack the capabilities to achieve basic functionings, despite having similar formal rights or income levels (Chiappero-Martinetti et al., 2020).

Applied to digital transformation, this approach suggests that digital transformation is not inherently valuable but is potential instrument for expanding human capabilities. It enhances freedoms in important areas such as access to healthcare via telemedicine, education through e-learning platforms, economic participation via digital financial services, and civic engagement through e-government (Johnstone, 2007; Oosterlaken & Hoven, 2011; Zelenkov & Lashkevich, 2023; Müller-Salo, 2025).

For instance, telemedicine reduces geographic barriers to health services; e-learning platforms democratize education; digital finance fosters economic participation; and e-government services enhance transparency and service delivery (Djatmiko et al., 2025).

However, the capability approach emphasizes that the mere presence of technology does not automatically translate into improved well-being. The conversion of digital access into valuable functionings is mediated by a range of personal, social, and environmental "conversion factors," including digital literacy, social norms, and the quality of supporting infrastructure (Oosterlaken & Hoven, 2011; Kimhur, 2020; Kim & Adu-Ampong, 2024; Müller-Salo, 2025).

Thus, digital transformation reduces social inequalities only if it expands the real freedoms of disadvantaged groups. If digital access remains limited to advantaged groups, or if disadvantaged groups lack the necessary conversion factors, digital transformation may reinforce or exacerbate existing inequalities.

Empirical research on the effect of digital transformation on social inequality presents a complex picture, with evidence supporting both inequality reduction and potential aggravation depending on context and developmental stage. Previous studies show that the digital economy is likely to have a dampening effect on income inequality, for

instance, research across the EU28 found that the digital economy consistently dampens income inequality, with a more pronounced effect in capitalist nations than in post-communist ones (Tian & Xiang, 2024). Similarly, studies on OECD countries and China suggest that digital transformation can increase labor's share of income and reduce managerial pay gaps, particularly in state-owned and labor-intensive enterprises (Li et al., 2023a; Li et al., 2023b; Li et al., 2023c). The mechanism often involves boosted R&D investment and innovation performance

The sustainability perspective further reinforces this view. Research on the EU-27 shows that a socially sustainable digital transformation, as seen in Finland and Denmark, strongly supports the achievement of sustainable development goals, whereas countries with higher pre-existing inequality perform worse (Nosratabadi et al., 2023). This suggests that inclusive digital policies are integral to equitable development. Global analyses confirm that key mechanisms for this reduction are digital inclusion and strong regulatory quality, which help ensure the benefits of technology are widely shared (Adam et al., 2025).

Other studies show that digital transformation reduces regional disparities when paired with targeted investment (Sang, 2024), and increases labor's share of income (Li et al., 2023c).

Conversely, if digital technologies are accessible only to already-advantaged groups, or if disadvantaged groups lack the conversion factors to translate digital access into improved functionings, digital transformation may reinforce or even exacerbate existing inequalities. Specifically, literacy gaps, infrastructure deficits, and institutional barriers disproportionately affect marginalized groups (Djatmiko et al., 2025). Similarly, a U-shaped relationship between digital transformation and inequality in OECD countries is putted in evidence, indicating that unregulated digital expansion can widen disparities (Gyau et al., 2025). A further key risk, particularly in emerging economies, is that the rapid transition to digital technologies accelerates premature deindustrialization, the reduction of industrial activity or capacity in a region or economy, disrupting the conventional process for economic mobility among lower-skilled workers (Tekic & Koroteev, 2021).

Thus, we formulate our first hypothesis:

H1: Digital transformation reduces social inequality.

2.2. The moderating effect of institutional quality

Based on institutional theory (North, 1990), the national context, particularly the quality of its institutions, affects digital transformation-social inequalities relationship. Institutions, defined as the formal rules such as laws, regulations and policies, and informal norms and conventions constraints that structure human interaction (Shevchenko, 2023; Hinings et al., 2018; Ullah et al., 2021), shape both individual incentives and the effectiveness of digital transformation initiatives.

Several relevant dimensions of institutional quality are important to understand how digital transformation influences social inequalities.

The institutional perspective is relevant to explain cross-country variation in the effects of digital transformation. In countries with strong institutions, characterized by effective governance, robust rule of law, quality regulation, and political stability, digital transformation initiatives are more likely to be well-designed, effectively implemented, sustained over time, and broadly accessible, including to disadvantaged groups. Such institutional conditions enable digital infrastructure investments to translate into improved service delivery in health, education, and public administration, thereby reducing social inequalities

Conversely, in countries with weak institutions, digital transformation faces multiple challenges. Limited government capacity may result in fragmented strategies, weak regulatory frameworks can lead to monopolistic practices that restrict and raise the cost of digital access, corruption may divert resources toward politically connected elites, and weak rule of law can weaken trust in digital services. Political instability further disrupts the sustained implementation necessary for digital initiatives to achieve their potential. In such contexts, digital transformation is likely to benefit already-advantaged populations, typically urban and educated, while failing to reach disadvantaged groups who face structural and institutional barriers to access and effective use.

Empirical research confirms the moderating role of institutions. In African economies, institutional quality is a critical transmission channel that enables digital financial literacy to translate into effective financial inclusion and poverty reduction (Okoli, 2025). Studies confirm that digital transformation development improves income distribution, and this effect is significantly strengthened when combined with high-quality governance and e-government (Dossou et al., 2025). Furthermore, governance quality determines how structural transformation, including its digital component,

affects inequality, with robust institutions ensuring a more equitable distribution of benefits (Popogbe & Olohunlana, 2025).

Evidence from the MENA region specifically highlights how weak institutions can constrain the equalizing potential of digitalization. While e-government can improve governance metrics like corruption control, its benefits for sustainable development remain limited without strong institutional frameworks (Dhaoui, 2021). Research on digital financial inclusion in the region shows that low adoption among marginalized groups is directly linked to structural inequalities in education, labor participation, and information and communication technology (ICT) access, which institutional failures fail to address (Elouaourti & Ibourk, 2024). A scoping review of digital health in fragile MENA states concludes that weak institutions, manifested in low digital skills, poor infrastructure, and inadequate regulation, severely constrain the potential of digital health initiatives, often entrenching existing inequalities rather than alleviating them (El-Jardali et al., 2023).

Strong institutional quality facilitates well-designed, sustained, and accessible digital transformation, effectively translating investments into improved service delivery across health and education, thereby enhancing capabilities and reducing social inequalities. Conversely, weak institutions lead to fragmented strategies, expensive access due to monopolies, resource diversion through corruption, and a lack of trust, resulting in digital transformation primarily benefiting already-advantaged populations and reinforcing existing inequalities.

2.2.2. The moderating effect of government effectiveness

Government effectiveness shapes the ability of public institutions to design, implement, and sustain digital transformation initiatives. Highly effective governments can formulate robust digital strategies, coordinate across ministries and agencies, allocate resources efficiently, manage large-scale digital infrastructure projects, and adjust policies in response to implementation feedback. Such countries are therefore better positioned to use digital technologies for public service delivery—expanding e-government services that improve access to social protection, deploying digital health systems that reach underserved communities, and supporting online educational platforms that broaden learning opportunities (Yang et al., 2024). In contrast, limited government capacity often leads to poorly designed or weakly implemented digital initiatives that fail to reach intended beneficiaries or suffer from technical malfunctions, inadequate maintenance, or insufficient integration with existing service delivery systems (Ullah et al., 2021).

Thus, we formulate the following hypothesis :

H2: The negative relationship between digital transformation and social inequalities is stronger in countries with effective governance.

2.2.2. The moderating effect of law and the control of corruption

The rule of law and the control of corruption shape whether digital infrastructure investments and digital service delivery benefit the intended populations rather than being captured by elites or diverted through corrupt practices. Strong rule of law ensures that public digital infrastructure projects are competitively tendered, adequately supervised, and properly maintained. It also supports transparent digital government services, enabling citizens to hold public officials accountable for failures in service delivery. Conversely, when rule of law is weak and corruption is widespread, digital transformation efforts risk being appropriated by politically connected actors, with infrastructure contracts awarded based on patronage and digital services manipulated by officials who extract informal payments. Under such conditions, disadvantaged groups may find that digital platforms ostensibly designed to enhance inclusion instead reinforce existing patterns of exclusion and exploitation. Although digital anti-corruption tools offer potential remedies, their effectiveness depends on broader institutional alignment and governance quality (Mutungi et al., 2021).

H3: The negative relationship between digital transformation and social inequalities is stronger in countries with strong rule of law.

2.2.3. The moderating effect of regulatory quality

Regulatory quality reflects the extent to which governments design and implement policies that support private sector development, including the telecommunications and technology industries. Strong regulatory frameworks facilitate competitive digital markets, enforce universal service obligations, safeguard consumer rights in digital transactions, and curb monopolistic practices that limit digital access. Conversely, weak regulatory environments are likely to produce underdeveloped and spatially heterogeneous digital infrastructure concentrated in urban centers, high digital service costs that disproportionately exclude low-income groups (Jordanoski, 2025; Aldieri et al., 2025), and insufficient consumer protection mechanisms that weaken trust in digital platforms.

Thus, we formulate the following hypothesis :

H4: The negative relationship between digital transformation and social inequalities is stronger in countries with high regulatory quality.

2.2.4. The moderating effect of political stability and security

Political stability and security are important to the viability of long-term digital transformation and to attracting private investment in digital infrastructure. In contexts marked by conflict, instability, or insecurity, the development of digital systems is severely constrained: physical infrastructure may be damaged or destroyed, maintenance becomes difficult, and an uncertain business environment deters private sector participation. Instability also weakens policy continuity, disrupting the sustained implementation required for digital initiatives to mature and achieve their expected impact (Jordanoski, 2025; Ullah et al., 2021).

Thus, we formulate the following hypothesis:

H5: The negative relationship between digital transformation and social inequalities is stronger in countries with higher political stability.

3. Methodology and analysis

3.1.Sample

Our study focuses on a sample of 14 Arab MENA countries during the period 2012–2022. Retained MENA Arab countries with available data : Algeria , Egypt , Iraq , Jordan , Kuwait, Lebanon , Libya , Morocco , Oman , Qatar , Saudi Arabia , Tunisia , United Arab Emirates and Yemen.

3.2.Variables definitions

3.2.1. Dependent variable

Social inequalities (SI) are measured using World Bank indicators, conceptualizing inequality as a multidimensional function shaped by socioeconomic conditions, institutional capacity, and human development. We construct four composite indices using principal component analysis (PCA), retaining only indicators with factor loadings above 0.40 to ensure strong correlation with their respective dimensions:

1. Health and well-being index (H_ind) : It is composed of life expectancy at birth, under-five mortality rate, maternal mortality ratio, prevalence of undernourishment, immunization coverage, and the urban–rural population distribution, used as proxies for access to healthcare services and living conditions.
2. Education and economic participation index (EP_ind) : It includes primary and secondary school enrollment rates, government expenditure on education at all levels (primary, secondary, and tertiary), labor force participation, unemployment rate, and gross national income per capita, thereby capturing both educational attainment and access to economic opportunities.

3. Economic inequality and social inclusion index (EI_ind) : It combines poverty headcount ratios at national and societal poverty lines, the income share of the lowest 20%, the Gini index, the CPIA gender equality rating, female labor force participation, total labor force size, and the age-dependency ratio for the elderly, reflecting distributional fairness and social vulnerability.
4. Health infrastructure and spending index (HI_ind) : It is constructed using total government health expenditure (as a percentage of total government spending), current health expenditure (as a percentage of GDP), hospital beds per 1,000 people, and out-of-pocket health expenditure, capturing healthcare system capacity and financial accessibility.

Each index is derived using PCA with eigenvalues greater than 1.0, confirming that the principal components explain substantial variance and represent distinct dimensions of social inequality. The factor loadings reported in Table 1 (Panel A) further demonstrate the theoretical coherence and empirical robustness of these dimensions.

Table 1

3.2.2. Independent variable

Digital transformation (DT) is measured using data from the international telecommunication union and is based on five key indicators: active mobile broadband subscriptions, mobile cellular subscriptions, the proportion of internet users, the share of the population covered by at least a 3G network, and the percentage of inhabitants within mobile-cellular signal range. A composite Digital transformation index is constructed through PCA. All composite indices are normalized using min–max scaling to a 0–1 range to ensure comparability across dimensions and to facilitate interpretation of the results.

3.2.3. Moderating variables

We use four variables.

Government effectiveness (EFF_GOV) : It captures perceptions of the quality of public services, the professionalism and independence of the civil service, the quality of policy formulation and implementation, and the credibility of government commitments (Kaufmann et al., 2011). Higher values reflect more effective governance and service delivery.

Rule of law (RUL_LW) : It measures perceptions of the extent to which individuals and institutions have confidence in, and comply with, societal rules, including the quality of contract enforcement, property rights, policing, and the judiciary, as well as

the prevalence of crime and violence (Kaufmann et al., 2011). This variable reflects the strength and reliability of legal institutions.

Regulatory quality (RG_QUA) : It captures perceptions of the government's ability to design and implement sound policies and regulations that support private sector development while minimizing unnecessary regulatory burdens and barriers to business activity (Kaufmann et al., 2011). It reflects the overall business-friendliness and efficiency of the regulatory environment.

Political stability and absence of violence (POL_STB) : It measures perceptions of the likelihood that the government will be destabilized or removed through unconstitutional or violent means, including politically motivated violence and terrorism (Kaufmann et al., 2011). This indicator is particularly relevant in the MENA context, given the region's exposure to geopolitical instability and conflict risks.

3.2.4. Control variables

To isolate the net effect of digital transformation on social inequalities, we include a set of macroeconomic control variables that the literature identifies as key determinants of inequality.

GDP growth (GDP_GR) influences social consequences. Economic expansion can generate employment and increase fiscal capacity for social spending (Dollar & Kraay, 2002), yet the distributional effects depend on the inclusiveness of growth and the strength of institutions.

Inflation (INF) is included as a measure of macroeconomic stability, given that inflation disproportionately burdens low-income households by reducing real incomes and savings (Easterly & Fischer, 2001). Also, high inflation episodes are strongly associated with increased poverty and inequality, particularly in developing economies where the poor have limited access to inflation-hedging financial tools (Romer & Romer, 1998).

Trade openness (TR_OPE) is measured as total trade relative to GDP and captures the extent of a country's integration into the global economy. Greater openness promotes growth that benefits the poor proportionally (Dollar & Kraay, 2004). However, trade liberalization in developing countries has often contributed to rising wage inequality, largely due to skill-biased technological change and within-industry wage dispersion (Goldberg & Pavcnik, 2007).

Foreign direct investment (FDI) is expressed as a percentage of GDP, captures the distributional implications of cross-border capital flows. FDI can generate employment and foster technology transfer (Borensztein et al., 1998), but it may simultaneously

widen wage inequality by favoring skilled labor and concentrating activity in specific sectors or regions (Figini & Görg, 2011). Also, the impact of FDI depends on host countries' absorptive capacity and levels of human capital (Te Velde, 2003). However, while FDI may increase inequality in the short run, its long-run effects can be equalizing when supported by adequate policies and institutional frameworks (Herzer & Nunnenkamp, 2013).

3.3. Empirical specification

To test hypothesis 1, we estimate equation 1

$$SI_{it+1} = \alpha_0 + \alpha_1 DT_{it} + Control\ variables + \varepsilon_{it} \quad (1)$$

To test the moderating effect of institutional quality (hypotheses H2, H3, H4, and H5), we estimate equation 2:

$$SI_{it+1} = \alpha_0 + \alpha_1 DT_{it} + \alpha_2 (DT_{it} \times MODERATOR_{it}) + \alpha_3 MODERATOR + Control\ variables + \varepsilon_{it} \quad (2)$$

where MODERATOR refers to one of the following institutional quality variables: EFF_GOV, RUL_LW, RG_QUA, or POL_STB.

To estimate these models, we employ the two-stage least squares (2SLS) approach. This methodology is motivated by the need to address potential endogeneity between social inequality and digital transformation. Endogeneity may arise if unobserved factors, such as cultural norms or omitted institutional variables, simultaneously affect both digital infrastructure and social inequalities, potentially biasing estimates. The 2SLS technique allows us to isolate exogenous variation in digital transformation using instrumental variables, a method widely validated in cross-country analyses of digital transformation.

Our instrumental variable is electrification, which constitutes an important input for digital technologies and serves as a strong predictor of ICT penetration and, consequently, digital transformation. Historical electrification does not directly affect social inequality once macroeconomic development, demographic structure, and institutional factors are controlled for, thereby satisfying the exogeneity requirement for valid instruments. This choice of instrument aligns with the theoretical argument that energy infrastructure enables digital adoption without independently influencing inequality consequences.

4. Empirical findings

4.1. Descriptive statistics

The descriptive statistics are presented in Table 2. As shown, digital transformation (DT) has a mean of 0.281, indicating a relatively low level of digital transformation across the sample, with moderate variation (standard deviation is equal to 0.174). This suggests that while some Arab MENA countries show higher digital adoption, the majority remain at lower levels of digital transformation.

Regarding social inequality, the health infrastructure and spending index (HI_ind), shows the lowest mean, reflecting constrained public health investment and service capacity. In contrast, the equity and social inclusion index (EI_ind) exhibits the highest social mean, suggesting relatively stronger performance in income redistribution and inclusion. The health and well-being index (H_ind) and education and economic participation index (EP_ind) sit near the midpoint, indicating moderate progress in health outcomes and human capital development.

Institutional quality is moderately weak overall: while regulatory quality (RG_QUA), rule of law (RUL_LW), and government effectiveness (EFF_GOV) hover around the mid-point, political stability (POL_STB) stands out as the weakest governance dimension, underlining fragility as a critical institutional constraint

Finally, macroeconomic control variables show more heterogeneous results. GDP growth (GDP_GR) averages 0.456, reflecting moderate economic expansion. Inflation (INF) has a mean of 0.046, with some negative values, indicating occasional deflationary episodes. Trade openness (TR_OPE) is relatively high on average (mean = 0.825), while FDI is comparatively low (mean = 0.021).

Table 2

4.2. Main findings

4.2.1. digital transformation - social inequality

Table 3 presents the regression results examining the impact of digital transformation on various dimensions of social inequality. The results indicate that digital transformation is positively associated with improvements in health and well-being, education and economic participation, economic inequality and social inclusion, as well as health infrastructure and spending. This suggests that higher levels of digital transformation contribute significantly to reducing social inequalities across multiple domains. These results support our first hypothesis H1. Overall, these results validate the capability approach's prediction that technology's value lies not in its mere presence but in its capacity to expand substantive freedoms, with the magnitude of effects

reflecting the relative ease with which digital access translates into capability expansion across different social domains.

The findings imply that by enhancing access to telemedicine, e-learning platforms, digital financial services, and e-government, digital technologies enable disadvantaged populations to achieve valuable functionings—such as being healthy, educated, and economically active—that were previously constrained by geographic, economic, or institutional barriers.

In terms of magnitude, the strongest effect of digital transformation is observed for education and economic participation, reflecting how digital platforms democratize access to learning opportunities and remote employment, thereby directly expanding economic freedoms.

The second largest effect is observed for economic inequality and social, suggesting that digital transformation facilitates more equitable income distribution and broader social participation through enhanced financial inclusion and civic engagement mechanisms. The positive coefficient for health and well-being confirms that digital health services reduce geographic barriers to healthcare, enabling individuals in remote or underserved areas to convert digital access into improved health outcomes

Although smaller in magnitude, the coefficient for health infrastructure and spending indicates that digital transformation still plays a modest but meaningful role in enhancing resource allocation and healthcare system efficiency.

Table 3

4.2.2. The moderating role of institutional quality

Table 4 presents the results examining the moderating role of institutional quality on the relationship between digital transformation and social inequality.

The regression results show that the effect of digital transformation on social inequality dimensions depends on institutional and governance factors.

First, effective governance (EFF_GOV) significantly strengthens the positive impact of digital transformation across all social inequality dimensions, as shown by the positive and statistically significant coefficients of the interaction term (DT × EFF_GOV). Therefore, hypothesis H2 is supported. These findings align with institutional theory, showing that countries with higher government effectiveness have the administrative capacity to design robust digital strategies, coordinate implementation across agencies, and ensure that digital services reach intended beneficiaries rather than being captured by elites. This suggests that countries with stronger institutions are better positioned to use digital transformation in reducing

social disparities. The consistent significance of this moderating effect across all four inequality dimensions confirms that effective governance creates the institutional conditions necessary for digital technologies to translate into capability expansion, particularly by ensuring service continuity, resource efficiency, and equitable access to digital infrastructure.

Second, the rule of law (RUL_LW) shows non-significant moderating effects across all dimensions, suggesting that the strength of legal institutions and contract enforcement mechanisms do not significantly moderate digital transformation-social inequalities relationship. Thus, hypothesis H2 is not supported. This unexpected finding may reflect the reality that in contexts where digital infrastructure deployment is primarily government-led rather than market-driven, judicial efficiency and property rights protection play a less direct role in determining whether digital access translates into reduced inequality.

Third, regulatory quality (RG_QUA) shows weak and inconsistent moderating effects, with significance appearing only for specific dimensions (education and economic participation and Health infrastructure and spending) while remaining non-significant for health and well-being and economic inclusion. This result lead us to conclude that hypothesis H4 is partially supported. These findings suggest that while sound regulatory frameworks can facilitate competitive digital markets and consumer protection in some domains—particularly education and health infrastructure—their influence remains context-specific and less determinative than government effectiveness. The capability approach helps explain this heterogeneity: regulatory quality primarily affects the availability and cost of digital infrastructure, but its impact on capability conversion depends on whether complementary factors—such as digital literacy and social norms—are present to enable disadvantaged groups to utilize available technologies.

Finally, political stability (POL_STB) significantly amplifies the effect of digital transformation, particularly for education, economic participation, and economic inequality indicators. Consequently, hypothesis H5 is supported. This finding aligns with institutional theory's arguments on the importance of sustained policy implementation: political stability enables the long-term investments in digital infrastructure and the continuity of digital service delivery necessary for disadvantaged populations to develop the skills and trust required to convert digital access into improved functionings. This implies that a stable political environment facilitates the translation of digital transformation into tangible improvements in social equality. In

contrast, political instability disrupts both the physical maintenance of digital infrastructure and the trust-building processes essential for marginalized groups to adopt and effectively use digital technologies, thereby limiting capability expansion.

Table 4

4.3. Additional evidence : Country development level

The relationship between digital transformation and social inequalities varies across different levels of economic and financial development.

The capability approach and institutional theory both predict such heterogeneity: countries at intermediate development levels potentially experience the strongest inequality-reducing effects as they possess sufficient institutional capacity to deploy digital technologies effectively while still having substantial disadvantaged populations who stand to benefit significantly from expanded digital access (Demir et al., 2022; Suhrab et al., 2023; Tian and Xiang, 2024; Khyareh, 2025). In contrast, low-income countries may lack the institutional infrastructure and complementary investments (electricity, digital literacy programs, regulatory frameworks) necessary to convert digital access into capability expansion, while high-income countries may exhibit ceiling effects where marginal improvements in digital transformation yield diminishing returns for inequality reduction because baseline access and capabilities are already high.

Consequently, we conduct subsample analysis based on regional and economic attributes. Specifically, we split our sample into GCC (gulf cooperation council) and non-GCC MENA countries. This classification is particularly meaningful as GCC countries (Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates) are characterized by significantly higher income levels, more advanced financial inclusion, well-developed digital infrastructure, and stronger institutional frameworks compared to non-GCC countries (Algeria, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Tunisia, and Yemen). This division enables us to examine whether digital transformation's inequality-reducing effects differ between high-income, financially developed contexts and lower-income, less financially inclusive environments, thereby testing whether the capability expansion potential of digital technologies depends on pre-existing economic and institutional conditions.

Table 5 presents the subsample results, revealing important heterogeneity in both the direct effects of digital transformation and the moderating role of institutional quality. For GCC countries, the direct effects of digital transformation on social inequality dimensions are positive but considerably smaller in magnitude across all dimensions.

This result aligns with the capability approach's prediction of diminishing marginal returns: in high-income contexts where baseline capabilities, digital literacy, and financial inclusion are already widespread, further digital expansion generates smaller gains because fundamental access barriers have been largely overcome. In contrast, for non-GCC countries, the direct effects are substantially larger across all inequality dimensions than GCC countries. This confirms that digital transformation generates far greater capability expansion in contexts where significant populations previously lacked access to basic services in health, education, and economic participation.

Moreover, institutional quality moderators become substantially more significant in non-GCC contexts: government effectiveness shows highly significant effects, as does regulatory quality. These effects are larger than in GCC countries, where institutional moderators remain largely weak or non-significant. This confirms institutional theory's prediction: in developing contexts with variable institutional capacity and limited financial inclusion, institutional quality becomes important in determining whether digital transformation expands freedoms equitably. Strong government effectiveness enables good digital inclusion strategies, infrastructure in underserved areas, digital literacy programs, subsidized access, ensuring digital transformation reaches populations who stand to gain most from capability expansion. High regulatory quality prevents monopolistic pricing, ensures service obligations, and builds trust in digital platforms among previously excluded groups. Political stability shows mixed moderating effects in non-GCC countries, suggesting that in chronically unstable contexts, other institutional dimensions become more binding constraints on capability expansion.

Conclusion

This paper studied the impact of digital transformation on social inequalities of a sample of 14 Arab MENA countries observed from 2012 to 2022. Specifically, this paper examined the relationship between digital transformation and social inequalities as moderated by government effectiveness, rule of law, regulatory quality, and political stability. We considered two complementary theoretical perspectives: the capability approach and institutional theory. Our analysis is informed by theoretical insights drawn from the capability approach, which examines how digital technologies expand human freedoms and functionings, and institutional theory, which explains how institutional quality shapes the effectiveness of digital transformation initiatives.

The results show that digital transformation has a positive and significant effect on reducing social inequalities across all dimensions (health and well-being, education and economic participation, economic inequality and social inclusion, and health infrastructure and spending). For the moderating variables, government effectiveness and political stability strengthen the positive relationship between digital transformation and inequality reduction. Meanwhile, rule of law shows no significant moderating effect, and regulatory quality demonstrates weak and inconsistent moderating effects. Additional evidence has been put forward by distinguishing between GCC and non-GCC countries, revealing that digital transformation's inequality-reducing effects are substantially stronger in non-GCC countries, and institutional quality moderators are far more significant in these lower-income, less financially developed contexts.

Our results do not disprove the challenges of digital transformation in the MENA region but demonstrates its substantial potential for reducing social disparities when supported by strong institutional frameworks. Theoretically, the results support the capability approach and institutional theory, highlighting that digital technologies expand human capabilities, enabling access to healthcare, education, and economic opportunities, but this expansion is contingent upon institutional quality, particularly government effectiveness and political stability, which ensure equitable access and sustained implementation.

This study has many managerial, policy, and economic implications and delivers new insights to governments, policymakers, international development organizations, regulators, technology companies, and civil society organizations. Practically, our findings imply that governments in the MENA region have to prioritize digital transformation as a strategic tool for achieving inclusive development and reducing social inequalities. Policymakers have to be strategic when designing digital transformation initiatives, ensuring that investments in digital infrastructure are accompanied by complementary investments in digital literacy programs, affordable access policies, and institutional capacity building. As digital transformation's inequality-reducing potential depends on institutional quality, governments have to strengthen their administrative effectiveness, ensure policy continuity through political stability, and implement sound regulatory frameworks that promote competitive digital markets and prevent monopolistic practices. Our study further suggests that government effectiveness and political stability are the most critical institutional

dimensions that amplify digital transformation's positive effects on social equality. Following this study, policymakers should prioritize institutional reforms that enhance government capacity to design robust digital strategies, coordinate implementation across agencies, allocate resources efficiently, and ensure that digital services reach disadvantaged populations rather than being captured by elites.

Moreover, to maximize social impact, we encourage international development organizations and regional institutions to prioritize digital inclusion programs in non-GCC MENA countries, where digital technologies can generate transformative capability expansion for previously excluded populations. In this regard, it is recommended to implement targeted digital inclusion strategies that address multiple barriers simultaneously: building digital infrastructure in underserved rural areas, providing subsidized internet access for low-income households, offering digital literacy training programs tailored to different population segments, and ensuring that e-government, e-health, and e-learning services are designed with the needs of marginalized communities in mind. Furthermore, we suggest for policymakers and regulators first, to create monitoring frameworks that track digital inclusion indicators alongside traditional digital adoption metrics, ensuring that digital transformation initiatives are evaluated based on their success in expanding capabilities for disadvantaged populations rather than simply measuring infrastructure deployment or usage rates, and second, to create governance mechanisms that ensure digital transformation projects incorporate equity considerations from the design phase through implementation and evaluation, protecting the interests of digitally excluded populations and preventing digital transformation from reinforcing existing inequalities. Finally, technology companies and digital service providers operating in the MENA region have to recognize their role as partners in inclusive development by adopting business models that prioritize accessibility and affordability, designing user interfaces that accommodate low digital literacy levels, and collaborating with governments and civil society organizations to ensure their services reach underserved populations.

For the limitations and future studies, although this study examined a large sample of 14 Arab MENA countries over an 11-year period and considered the significant moderating role of four key institutional quality dimensions in the digital transformation-social inequality relationship, it has some limitations. First, a composite measure of digital transformation is considered in the current study. Future research can carry out interesting extensions by separating different dimensions of digital

transformation—such as digital infrastructure, digital skills and literacy, and digital service adoption—on the one hand, and distinguishing between different types of digital technologies (e-government, telemedicine, e-learning platforms, digital financial services) on the other. As each digital transformation dimension and technology type has its own mechanisms for capability expansion, such analysis is helpful and leads to testing which dimensions of digital transformation affect social inequality most significantly. Second, to deepen our analysis and test if the relationship between digital transformation and social inequality is different for countries with high versus low baseline inequality levels, quantile regression can be used. This estimation method offers new insights to determine the effect of digital transformation on social inequality at different quantiles. The idea behind using quantile regression to extend this study is that countries with high baseline inequality may face different barriers to capability expansion and may require more intensive institutional support to ensure that digital transformation benefits reach the most disadvantaged populations. Third, our study covers the period 2012-2022, which includes relatively stable years but also periods of political transition and regional instability. Nevertheless, the MENA region continues to face various crises and disruptions. Therefore, it will be interesting to replicate this study focusing specifically on crisis periods to examine whether digital transformation's inequality-reducing effects persist during turbulent times or whether institutional quality becomes even more critical during crises. Finally, our study shows that institutional quality moderates the relationship between digital transformation and social inequality; it will be interesting to extend our analysis to examine additional contextual factors that may influence this relationship, such as the level of internet affordability, the prevalence of digital payment systems, cultural attitudes toward technology adoption, gender norms that may create differential access to digital technologies, and the role of civil society organizations in promoting digital inclusion initiatives.

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Table 1. PCA results

Panel A : Social inequality dimensions			
Social Axis	Eigenvalue	Indicators	Factor Loading
Health and well-being (H_ind)	3.065	Life expectancy at birth	0.55
		Under-five mortality rate	-0.42
		Maternal mortality ratio	-0.58
		Prevalence of undernourishment	-0.46
		Immunization rate (% of children ages 12-23 months)	0.39
		Urban population (% of total population)	0.58
		Rural population (% of total population)	-0.42
Education and economic participation (EP_ind)	2.01	Primary school enrollment (% gross)	0.41
		Governmeent expenditure on education	0.53
		Total labor force participation rate	0.58
		Total unemployment rate (% of total labor force)	-0.71
		Gross national income per capita	0.39
Equity and social inclusion (EI_ind)	1.58	Poverty headcount ratio at national poverty line (% of population)	-0.54
		Income share held by lowest 20%	0.67
		Gini index	-0.59
		Female labor force participation (% of total labor force)	0.38
		Total labor force	0.46
		Age dependency ratio (old)	-0.42
Health infrastructure and spending (HI_ind)	2.38	Total government expenditure on health (% of government expenditure)	0.56
		Hospital beds (per 1,000 people)	0.41
		Current health expenditure (% of GDP)	0.58
		Out-of-pocket expenditure (% of current health expenditure)	-0.53
Panel B : Digital transformation axe			
Digital transformation index (DT)	2.06	Active mobile broadband subscriptions	0.388
		Mobile cellular subscriptions	0.501
		Proportion of internet users	0.434
		Population covered by at least a 3G network	0.498
		Percentage of inhabitants within mobile-cellular range	0.434

Table 2. Descriptive Statistics

Variables	Mean	Std. Dev.	Min	Max
DT	0.281	0.174	0	1
H_ind	0.495	0.478	0	1
EP_ind	0.526	0.951	0	1
EI_ind	0.598	0.481	0	1
HI_ind	0.410	0.310	0	1
EFF_GOV	0.456	0.127	0	1
RUL_LW	0.469	0.138	0	1
RG_QUA	0.482	0.144	0	1
POL_STB	0.351	0.185	0	1
GDP_GR	0.456	0.127	0	1
INF	0.046	0.068	-0.048	0.213
TR_OPE	0.825	0.356	0.294	0.181
FDI	0.021	0.0345	-0.234	0.189

Table 3. Impact of digital transformation on social dimensions of inequality

	H_ind	EP_ind	EI_ind	HI_ind
DT	0.0169***	0.0560**	0.0480***	0.0753*
	(0.0019)	(0.0264)	(0.0156)	(0.0405)
GDP_GR	0.0350	0.0310	0.0323*	0.0356**
	(0.0352)	(0.0315)	(0.0273)	(0.0146)
INF	0.0599***	0.0796***	0.1804***	0.0789**
	(0.0204)	(0.0292)	(0.0455)	(0.0368)
TR_OPE	0.0994**	0.0753	-0.0954*	0.1302*
	(0.0444)	(0.0577)	(0.0519)	(0.0694)
FDI	-0.0352***	0.0238***	0.0384***	0.0186***
	(0.0107)	(0.0073)	(0.0102)	(0.0087)
Years dummies	Included	Included	Included	Included
Countries dummies	Included	Included	Included	Included
R-squared	0.462	0.408	0.521	0.517

. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively

Table 4 : Impact of digital transformation on social dimensions of inequality : The moderating role of institutional quality

	H_ind				EP_ind				EI_ind				HI_ind			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
DT	0.019***	0.036**	0.043***	0.065***	0.016***	0.038**	0.045**	0.056***	0.014**	0.041**	0.048**	0.051***	0.013***	0.049**	0.075*	0.012***
	(0.002)	(0.016)	(0.016)	(0.021)	(0.002)	(0.019)	(0.018)	(0.021)	(0.006)	(0.021)	(0.020)	(0.038)	(0.005)	(0.027)	(0.041)	(0.001)
EFF_GOV	0.031***				0.036***				0.047***				0.096***			
	(0.008)				(0.014)				(0.013)				(0.017)			
RUL_LW		0.002				0.007				0.004				0.005		
		(0.016)				(0.010)				(0.086)				(0.073)		
RG_QUA			0.021				0.035*				0.020				0.028*	
			(0.015)				(0.020)				(0.012)				(0.016)	
POL_STB				0.026***				0.021**				0.017***				0.035***
				(0.005)				(0.009)				(0.004)				(0.005)
DT×EFF_GOV	0.018***				0.014*				0.025**				0.051***			
	(0.007)				(0.008)				(0.011)				(0.014)			
DT×RUL_LW		0.001				0.002				0.002				0.003		
		(0.014)				(0.050)				(0.073)				(0.062)		
DT×RG_QUA			0.011				0.014				0.010				0.015	
			(0.013)				(0.009)				(0.011)				(0.014)	
DT×POL_STB				0.014***				0.010***				0.009***				0.018***
				(0.004)				(0.002)				(0.003)				(0.004)
Control variables	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Years dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Countries dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-squared	0.245	0.424	0.497	0.445	0.331	0.349	0.602	0.581	0.299	0.552	0.463	0.378	0.304	0.578	0.458	0.578

Table 5 : Impact of digital transformation on social dimensions of inequality : Additional Evidence – GCC vs. Non-GCC

Panel A : GCC countries

	H_ind				EP_ind				EI_ind				HI_ind			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
DT	0.009***	0.006**	0.043***	0.065***	0.016***	0.038**	0.045**	0.056***	0.014**	0.041**	0.048**	0.051***	0.013***	0.049**	0.075*	0.012***
	(0.002)	(0.016)	(0.016)	(0.021)	(0.002)	(0.019)	(0.018)	(0.021)	(0.006)	(0.021)	(0.020)	(0.038)	(0.005)	(0.027)	(0.041)	(0.001)
EFF GOV	0.031***				0.036***				0.047***				0.096***			
	(0.008)				(0.014)				(0.013)				(0.017)			
RUL LW		0.002				0.007				0.004				0.005		
		(0.016)				(0.010)				(0.086)				(0.073)		
RG QUA			0.021				0.035*				0.020				0.028*	
			(0.015)				(0.020)				(0.012)				(0.016)	
POL STB				0.026***				0.021**				0.017***				0.035***
				(0.005)				(0.009)				(0.004)				(0.005)
DT×EFF GOV	0.018***				0.014*				0.025**				0.051***			
	(0.007)				(0.008)				(0.011)				(0.014)			
DT×RUL LW		0.001				0.002				0.002				0.003		
		(0.014)				(0.050)				(0.073)				(0.062)		
DT×RG QUA			0.011				0.014				0.010				0.015	
			(0.013)				(0.009)				(0.011)				(0.014)	
DT×POL STB				0.014***				0.010***				0.009***				0.018***
				(0.004)				(0.002)				(0.003)				(0.004)
Control variables	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Years dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Countries dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-squared	0.357	0.335	0.312	0.473	0.128	0.134	0.149	0.103	0.204	0.195	0.265	0.205	0.384	0.308	0.278	0.285

Panel B: Non GCC countries

	H_ind				EP_ind				EI_ind				HI_ind			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
DT	0.032***	0.064***	0.059***	0.078**	0.064***	0.106*	0.078***	0.109***	0.118***	0.176*	0.104***	0.133***	0.116***	0.167***	0.137***	0.101***
	(0.003)	(0.014)	(0.020)	(0.036)	(0.014)	(0.057)	(0.024)	(0.033)	(0.018)	(0.095)	(0.027)	(0.026)	(0.018)	(0.047)	(0.031)	(0.015)
EFF GOV	0.072***				0.143***				0.189***				0.390***			
	(0.002)				(0.036)				(0.041)				(0.056)			
RUL LW		0.014				0.027				0.007				0.009		
		(0.016)				(0.026)				(0.010)				(0.009)		
RG QUA			0.070**				0.141***				0.186***				0.262***	
			(0.032)				(0.051)				(0.064)				(0.087)	
POL STB				0.060***				0.121***				0.030***				0.062***
				(0.014)				(0.023)				(0.009)				(0.012)
DT×EFF GOV	0.191***				0.382***				0.281***				0.207***			
	(0.021)				(0.034)				(0.040)				(0.047)			
DT×RUL LW		0.023				0.028								0.005		
		(0.040)				(0.032)								(0.007)		
DT×RG QUA			0.166***				0.321***				0.189***				0.139*	
			(0.049)				(0.075)				(0.063)				(0.074)	
DT×POL STB				0.201				0.201				0.127				0.095
				(0.359)				(0.306)				(0.207)				(0.111)
Control variables	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Years dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Countries dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-squared	0.165	0.195	0.319	0.263	0.155	0.188	0.244	0.201	0.104	0.211	0.249	0.199	0.195	0.292	0.188	0.192