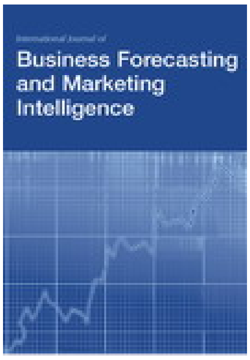

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Global perspective of the effects of digital financial inclusion and ICT intensity on socio-economic development

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Abstract: Although digital financial inclusion (DFI) has recently received scholarly attention, large sections of these studies focused on the impacts, drivers, inhibiting factors, and firms, single and cross-countries. This study combines the partial least square structural equation modelling (PLS-SEM) and necessary condition analysis (NCA), a conceptual framework, and a global dataset to investigate the effects of DFI and the mediating role of ICT intensity on socio-economic development. The results show that ICT intensity and DFI positively influence socio-economic development and are necessary conditions. We also found that ICT regulation does not mediate the nexus between DFI, ICT intensity, and socio-economic development. The findings of this study offer global insights into the discourse and highlight theoretically the critical success factors in ICT4D (ICT for development) initiatives. It also provides insights on the level of ICT-based factors necessary for a country's socio-economic development while making better use of its limited resources.

Keywords: digital financial inclusion; DFI; information and communication technology; ICT; ICT intensity; socio-economic development; global perspective; necessary condition analysis; NCA; partial least squared-structural equation modelling; PLS-SEM.

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1 Introduction

Through the advancement of information and communication technology (ICT), digital financial inclusion (DFI) has enabled many countries to provide digital financial services (DFS) for excluded populations (Lefophane and Kalaba, 2021). Stable economic growth, for both customers and economies, is an advantage of this development. DFI is described as excluded and less deprived populations with digital access to and use of formal financial services. Such services are personalized to the needs of the consumer and supplied conscientiously, at a cost that is both reasonable for the user and sustainable for the supplier. Many countries are taking deliberate steps to leverage DFS to promote development and improve living standards through DFI (Lechman and Popowska, 2022). DFI is empirically connected to socio-economic development through the delivery of competitive digital services (Mhlanga, 2020). Many sectors make up an economy, however, arguably, it is commonly recognized that two critical contributors to socio-economic development are financial sector expansion and advancements in ICT (Pradhan et al., 2021). Millions of impoverished clients are switching from cash-based transactions to formal financial services due to gains in the affordability and accessibility of digital financial services. Discussions regarding the financial sector's contribution to socio-economic development have raged for a long time (Mushtaq and Bruneau, 2019), and it is considered that ICT penetration in this sector has increased. Even though the term 'socioeconomic development' is frequently used in practice and research, its meaning is not always straightforward. The term 'development' connotes improvement or advancement and may be defined as any willfully or subconsciously conducted behaviour that aims at improving society. The descriptor 'socioeconomic' is a blend of two nouns and refers to social and economic elements such as education and revenues.

As a result, socio-economic development is an advancement in social and economic situations that affect society, organizations, and individuals.

DFI has recently received scholarly attention (Peric, 2015). Large sections of these studies focused on the impacts, driving, and inhibiting forces of DFI. Soriano (2017) for instance, identifies that factors such as the lack of official identity systems and high financial illiteracy impede DFI. Formal financial services (including savings, credit, and insurance) have long been recognized as an important driver of socio-economic development, and as such, the availability of such services to the whole public is often considered a measure of financial inclusion (Pradhan and Sahoo, 2021). Aziz and Naima (2021) posit that financial inclusion may bring the poor into the formal sector and ensure financial connectedness with services like energy utility bills and fees. Mushtaq and Bruneau (2019) also found that ICTs may aid the poor in several ways, including e-banking, mobile banking, ATMs, access to timely and reliable information, and better connectivity with financial service providers. For a more inclusive society, financial inclusion plays a major role. Digital financial systems (DFS) have become a driver of financial inclusion in recent years. The greater use of DFS in an economy contributes to the overall development of the economy by increasing financial inclusion, which encourages the growth of the financial sector. ICT has stood out as a tool for financial inclusion and has been used as a saving vehicle especially amongst the poorest through the concept of DFI.

Given the pervasiveness of ICTs in our daily lives, its impact on socio-economic development has recently received a lot of scholarly attention (Palvia et al., 2017; Roztocki et al., 2019). However, while the literature on the effects of ICTs on improving socio-economic development in specific countries is contradictory, the evidence at the global level is limited. Also, evidence on the links between ICTs, DFI, and socio-economic development is still not found in information systems literature. This study identifies the role that DFI plays in this socio-economic development and shows how various aspects of society, technology, business, and governmental policy relate to socio-economic development at the global level. Through a conceptual framework and the combination of partial least square structural equation modelling (PLS-SEM) and necessary condition analysis (NCA) techniques, this study investigates the cause-effect relations between DFI, and ICT intensity, ICT regulation, and socioeconomic development. NCA understands cause-effect relations as 'necessary but not sufficient'. It means that without the right level of the cause, a certain effect cannot occur. The findings soughts to provide new theoretical and practical insights by identifying the level of a factor (i.e., DFI, ICT intensity, ICT regulation) that must be put and kept in place for having the outcome (socioeconomic development). Therefore, the purpose of this research is to examine the effects of DFI, ICT intensity, and the mediating effects of ICT regulation on the socio-economic development at the global level based on a secondary dataset from the network readiness index (NRI). More specifically, our research questions/objectives are the following:

a What are the effects of DFI and ICT intensity on the socio-economic development of citizens?

b What are the mediating effects of ICT regulation on the relationship between DFI, ICT intensity, and economic development?

c What are the critical conditions necessary for socio-economic development?

The novelty of this research stems from it being the first to adopt a multi-analytical approach by combining PLS-SEM and NCA, a conceptual framework, and a global dataset to investigate the effects of DFI and the mediating role of ICT intensity on socio-economic development. The findings provide significant contributions to theory and practice as follows. First, it provides a global view of the effects of the association between DFI, ICT intensity, and socio-economic development as well as the mediating role of ICT regulation. The study also builds a theoretical framework to specifically identify the level of DFI, ICT regulation, and ICT usage that is required for a country to attain socio-economic development through a multi-analytical approach. This framework is an extension and adaptation of Roztocki's et al. (2019) "multi-dimensional framework for the role of ICT in socio-economic development". By adopting this framework and combining PLS-SEM and NCA, we offer global insights into the discourse and highlight theoretically the critical success factors in ICT4D (ICT for development) initiatives. The findings can offer insights into the ongoing works on financial inclusion as a viable tool for alleviating poverty in developing and impoverished nations (Khera et al., 2021) by making known the level of necessary conditions required. For practice, various stakeholders, e.g., the government, NGOs, and private corporations would know what ICT-based factors contribute (and those that do not contribute) to the socio-economic development of a country and what their level of contributions are, and the consequences, both intended and unintended, so that they can use their limited resources in more effective ways. Section 2 discusses the literature and the theoretical foundation of the study; section explains the hypothesis of our model; Section 4 outlines the methodology and explains the data, constructs, and measurement items used; results of the analysis are reported in Section 5; Section 6 presents a discussion on the findings; whereas Section 7 present conclusion of the study.

2 Literature review

2.1 DFI and socioeconomic development

Within the information systems literature, DFI has been addressed in three categories: environmental factors, drivers, and the impact of DFS (Mushtaq and Bruneau, 2019; Ozili, 2018; Senyo et al., 2021). Table 1 shows a selected number of these studies. Within the impact of the DFS domain, a recent systematic literature review by Kim et al (2018) reveal that attempts to provide empirical findings on the linkages between digital financial services, financial inclusion, and development have been rather scant. These few research focused on a single nation or organization (Akpaku, 2022). These studies often rely on survey-based data and a single aspect of financial inclusion with no emphasis on the role of technology. Khera et al. (2021) conducted a cross-country study that analyzes the determinants of mobile money adoption using data across seven African countries between 2014 to 2017. Ahmad et al (2021) find that the adopters of DFI in China tend to be younger, wealthier, better educated, and urban residents. The second area includes specific ICT projects such as social media, and e-government platforms, and their impact on development. Studies on ICT for development addressing the impacts of DFI and ICT intensity on socioeconomic development from a global viewpoint are scanty in the current literature. What comes closer is a working paper by Khera et al. (2021) which attempts to investigate whether DFI unlocks growth. The authors used the ordinary least square (OLS) approach and focused on individual countries. The choice of research methods and the absence of theoretical foundations indicate limited variety and depth. the findings could not highlight the critical factors necessary for attaining socio-economic growth. The third area is focused on drivers of DFI.

Table 1 Summary of selected DFI studies

Authors	*Underpinning theories*	*Context, methodology, dataset*	*Constructs*
Mushtaq and Bruneau (2019)	Conceptual framework	Between 2001 and 2012, the study was done in France utilizing a panel dataset of sixty-two countries.	"ICT, Financial Inclusion and Poverty"
Nedungadi et al. (2018)	The digital literacy education model	This research used the proposed framework to develop an educational model for training over 1,000 indigenous people in India utilizing an integrated curriculum for digital literacies in distant communities.	"Information, Health, Education and Financial Literacies, e-governance Services and e-Safety"
Eton et al. (2021)	Conceptual framework	The study was cross-sectional and conducted in Uganda. Inferential statistics were utilized using a descriptive design. They used correlation and regression.	Conceptual framework
Mhlanga (2020)	Conceptual framework	Analyzed the influence of AI on DFI.	"Risk detection, measurement and management, information asymmetry, customer support, chatbots, fraud detection, and cybersecurity"
Soekarno and Setiawati (2020)	TAM and UTAUT	The study was carried out in Indonesia with 622 respondents. The ordinal logistic regression model was used	"Performance expectancy, habit, and effort expectancy"
Chikondi Daka and Phiri (2019)	UTAUT	The study was carried out in Zambia with 313 respondents. Data was analyzed using SPSS descriptive analysis	"Performance expectancy, effort expectancy, facilitating conditions, behaviour intention, Social influence"
Wang and He (2020)	Asset-based vulnerability model	The study was carried out in China with 1900 rural households	"Risk-induced vulnerability, Structural vulnerability"
Mouna and Jarboui (2021)	Conceptual Framework	The study was done in China. The authors estimate probit using MENA microdata from the 2017 Global Findex database.	"Age, income, education, use, digital financial services"

Table 1 Summary of selected DFI studies (continued)

Authors	*Underpinning theories*	*Context, methodology, dataset*	*Constructs*
Senyo et al. (2021)	UTAUT	The study analyzed 294 survey responses from Ghanaian mobile money users. The data were analyzed using a qualitative comparative analysis of fuzzy sets.	"Performance expectancy, Effort expectancy, Facilitating conditions, Social influence, Behavioral intention"

This study makes three key contributions to the information systems literature. First, to date, the mediating effects of ICT regulation on the relationship between DFI, ICT intensity, and economic development are not empirically examined. Second, the effects of DFI and ICT intensity on the socio-economic development of citizens are not understood at the global level. Third, theory-driven and analytical approaches that reveal the critical factors that must be managed for socio-economic development are missing. To address these issues and gaps, this study employs a conceptual framework to investigate the nexus between DFI, ICT intensity, ICT regulation, and socioeconomic development at the global by combining PLS-SEM and NCA. Researchers and policymakers can employ NCA and PLS-SEM to evaluate the factors that lead to the best potential outcome (Dul, 2016). NCA identifies the elements that are crucial to obtaining a certain outcome by determining the amount of a factor (e.g., DFI, ICT intensity, ICT regulation) that must be implemented and maintained in order to achieve the desired result (socioeconomic development). Failure of the outcome is certain if a crucial condition is not met, and modifications to other contributing circumstances are rendered ineffectual. This is independent of other factors; consequently, the required condition might be a single bottleneck, crucial factor, limitation, disqualifier, or other obstructive factors. We present new theoretical and practical insights to help policymakers and researchers identify the aspects that might lead to the best potential outcome.

3 Theoretical foundation

We reviewed the current literature on ICT for socioeconomic development for existing theories or models in the field. The results showed that theories that focus on factors that explain the acceptance and use of ICTs dominate. Given that this study simultaneously focuses on social and economic aspects of development, we adapt a well-conceived theoretical framework developed by Roztocki et al. (2019) called the "Multi-dimensional framework for the role of ICT in socio-economic development (hereafter referred to as ICTFSED)". This framework was created after reviewing different frameworks discovered in existing studies. The concept describes socioeconomic development as changing or improving a person's, organization's, or society's social and economic situations. Thus, it is useful for analyzing socioeconomic development at various levels including individuals, organizations, and countries. In the framework, socioeconomic development serves as the dependent variable. The framework depicts the inverse orientations of several models in the literature, as such models examine elements that explain ICT adoption and use. The multi-dimensional framework for the role of ICT in socioeconomic development, on the other hand, incorporates ICT as an explainable variable for socio-economic development. The framework describes four critical components of socio-economic development namely policy, society, business, and technology. The four components are predictor variables that explain changes in the dependent variable which is socio-economic development. We employ the framework to investigate the effects of DFI on socioeconomic growth from a global perspective for two reasons. First, from our review of the literature on ICTs and socio-economic development, we identified that DFI, ICT regulation, and ICT intensity might have an impact on a country's socio-economic development. The concepts of the ICTFSED framework are related to these factors. Second, the framework is enriched with both technological, social, and economic factors to better explain our dependent variable. Next, the related concepts in the framework and how they relate to the latent variables in this study are discussed.

The Policy component includes laws, government policies, and institutional effects that influence socio-economic development. In this study, policy dimensions are identified as ICT regulatory bodies, laws, legal frameworks, and quality regulatory measures, which are put in place to protect and regulate harmful behaviour during electronic communications and facilitate secure electronic transactions through IT standards. The business dimension is concerned with commercial activities enabled by physical infrastructure in an economy. Infrastructure in this context refers to the core services and infrastructure needed for an economy to thrive. These comprise communications infrastructures such as Internet access, phones, and service providers such as health care, education, and law enforcement. The framework asserts that when such infrastructures are made available, countries will have access to digital financial services, participate in internet shopping, and spend money on computer software. This infrastructure impacts economies as it sets the basis for enabling DFI. The business dimension corresponds with the DFI explainable variable of our study. Last, the Technology dimension relates to ICT intensity, which comprises ICT and enabling technologies that help organizations and individuals get the most out of ICT. In this study, technology is any physical or intangible thing that can add value to a country's industrial, economic or cultural advancement (Roztocki et al., 2019). The intensity of the use of these technologies mutually sustains the socio-economic and business activities of nations.

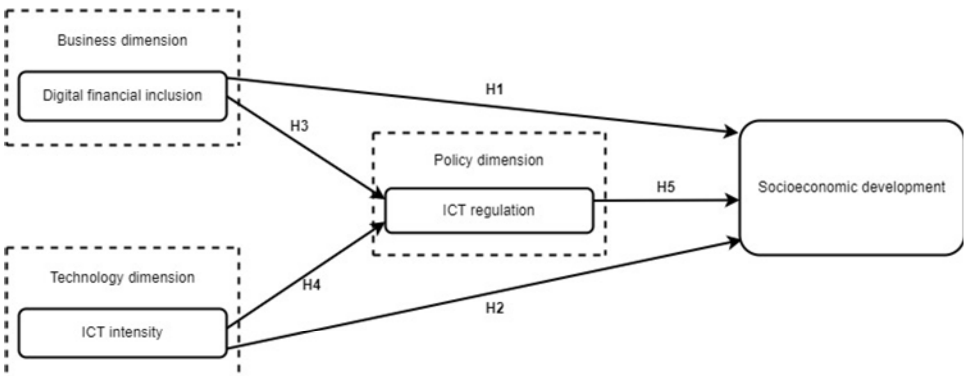
3.1 Research model and hypotheses development

This study adopts concepts from the conceptual framework ICTFSED, which was developed by Roztocki et al. (2019) to investigate the effects of DFI on socioeconomic development from a global perspective. Since there are impacts of the four dimensions namely, policy, business, technology, and society dimensions on socioeconomic development, we developed a conceptual model based on concepts inferred from the four dimensions of the ICTFSED framework. Therefore, the associations between the constructs in the model were derived from the ICTFSED framework, and the socio-economic development and ICT literature. These relationships are illustrated in Figure 1 and explained in detail in the sub-sections of this section.

In the last decade, a rising body of literature has demonstrated the importance of ICT in driving socio-economic development. Using ICT as a tool for financial inclusion has also been found to increase socio-economic development and decrease poverty and inequality (Mushtaq and Bruneau, 2019). The use of digital services may have an impact on daily financial operations, which could have a positive impact on society as a whole (Aziz and Naima, 2021). The empirical findings of Ahmad et al. (2021) show that DFI significantly affects socio-economic development. According to the authors, financial inclusion facilitates payments from individuals to governments, businesses to governments, and businesses to individuals. Affordability and innovation are key factors in achieving sustainable socio-economic development. For the same period from 2004 to 2010, Sethi and Acharya (2018) examined the dynamic relationship between financial inclusion and socio-economic development. Financial inclusion has a considerable beneficial impact on socio-economic development, implying that it contributes to socio-economic development. However, what is not clear is the effects of DFI on socio-economic development at the global level. We, therefore, hypothesized that:

H1 DFI has a positive effect on socio-economic development.

Figure 1 Research model



Source: Adapted from Roztocki et al. (2019)

3.1.1 ICT intensity and Socio-economic development

The intensity of the use of ICTs works in synergy in attaining socio-economic development. This implies that the impact of ICT on socio-economic development varies between countries, and more especially, between economic levels (Mayer et al., 2020). Despite this being evident at the individual and organizational level, it has not been examined at the global level. ICT's impact on development in developing and emerging markets may differ from that in developed markets. On one side, poor and emerging countries may lack absorptive capacities such as human capital or other complementary variables such as research and development, and spending, resulting in lower returns from ICT investments (Pradhan and Sahoo, 2021). This condition warrants examining the relationship between ICT and socio-economic development in each country separately (Fernandes et al., 2021). In the empirical analysis, the level of ICT intensity for socio-economic development is in three areas according to the findings of Lefophane and Kalaba (2021). First and foremost, the ICT-producing sector's labour and capital productivity. Second, increased productivity in non-ICT industries due to the use of ICT as a capital input contributes to the accumulation of capital. As a third benefit, higher usage of ICT in the economy contributes to the overall productivity of the economy. Consequently, we posit that:

H2 ICT intensity has a positive effect on socio-economic development.

3.1.2 DFI and ICT regulation

Numerous countries throughout the world have already begun to implement DFI fully (Senyo et al., 2021). DFI has the prospect of cost reduction and enhancing security, transparency, and transactional speed. It also allows for individualized financial services, which help the underprivileged while simultaneously ensuring banking sector stability. It is imperative for ICT regulation. Arguably, regulatory intervention is necessary for the economy because governments need to set up the rules to regulate the various industries and promote public welfare. ICT regulations are rules designed to handle issues related to ICT (Adam and Dzang Alhassan, 2021). This study asserts that DFI places a greater focus on the relevance of ICTs in extending the scope and usage of financial services by previously disadvantaged people. Therefore, we argue that

H3 DFI has a positive effect on ICT regulation.

3.1.3 ICT intensity and ICT regulation

Different countries are advancing in ICT, with online platforms being utilized to deliver public services such as online tax registration, online banking, providing information once and for all, and digital identity (Pappel et al., 2021). There has been intensive development in the availability and adoption of ICT in many parts of the world hence it proffers an opportunity for expanding ICT regulation. This is because when there is adequate regulation, it benefits citizens in an economy significantly (Hawthorne and Grzybowski, 2021). However, Bhattarai et al. (2019) argue that the difficulties of maintaining uniformity in the legislation may have made it difficult to suit people's needs, and it may only contain the bare minimum standards that are acceptable to all parties concerned. The intensive usage of ICT in countries has made it imperative to regulate its usage; it is therefore hypothesized that

H4 ICT intensity has a positive effect on ICT regulation.

3.1.4 ICT regulation and socio-economic development

ICTs are ubiquitous in almost every industry, and they are constantly improving to save users money. ICT also aids in the development of new products and processes (Mignamissi and Djijo, 2021). ICT regulation allows for a variety of online services, as well as information about travelling, studying, as well as access to information from other countries (Bhattarai et al., 2019). Not only will ICT regulation have a substantial impact on some specific sectors, but it will also have an impact on inclusive socio-economic development. As a result, ICT regulation is increasingly viewed as a driver of economic progress rather than a by-product of it. This is because citizens bear a disproportionate share of the costs associated with executing any legislation, whether domestic or international. The primary goal of ICT regulation is to offer required services to residents. Because citizens are the major stakeholders of services, meeting their expectations, resolving real-time issues, and providing speedier service should be a top priority while implementing the law (Pappel et al., 2021). Regulating ICT usage has an impact on the development of the economy. It is therefore hypothesized that:

H5 ICT regulation has a positive effect on socio-economic development.

4 Research methodology

4.1 Data, constructs, and measures

The dataset underpinning this research was obtained from the NRI's 2018 report (Dutta and Lanvin, 2020). The report containing the full dataset can be accessed from the organization's website at (https://networkreadinessindex.org). The NRI is an index published yearly by the World Economic Forum as part of its annual Global Information Technology Report. Its goal is to assess how prepared countries are to take advantage of the opportunities provided by ICT. This report contains all four latent constructs and their associated indicators, which demonstrated how the latent constructs were measured. For example, the latent variable DFI was measured using online access to financial accounts, internet shopping, and computer software spending. Table 2 lists the latent constructs and their associated indicators. There were a few missing values identified. These missing values were treated by conducting a missing value analysis in SPSS Version 26. The use of open-sourced data proved to be the most appropriate and cost-effective method for conducting this study, given it was impossible for the authors to directly collect original data from all the 134 nations. Additionally, since a good number of previous studies have utilized the data source and associated metrics, its reliability is not in question. We analyzed the data using both partial least squares-structural equation modelling (PLS-SEM), and the NCA techniques. According to Hair et al. (2011), the minimum sample size necessary for this investigation was 30, given the tenfold PLS-SEM principle for constructs with the most measurement items (i.e., 10*3). The recommended sample size was met considering that 134 countries were used.

Table 2 Constructs, indicators, and source of data

Latent constructs		*Indicators*	*Data source*
DFI	1	Online access to a financial account	Network Readiness Index Report 2018
	2	Internet shopping	
	3	Computer software spending	
ICT Intensity	1	Fixed broadband subscriptions	
	2	Internet users	
	3	Active mobile broadband subscriptions	
ICT Regulation	1	Legal framework adaptability to emerging technologies	
	2	Regulatory quality	
Socio-Economic Development	1	Socio-economic gap in the use of digital payments	
	2	SDG11 Sustainable Cities and Communities	
	3	SDG3 Good Health and Well Being	
	Labour productivity per employee		

In all, four constructs namely, DFI, ICT intensity, ICT regulation, and Socio-economic development were used in this study. DFI in this study is defined as the access and use of financial services by underserved populations using digital technologies such as FinTech, and ICTs. DFI is quantified by items such as online access to financial accounts, internet shopping, and computer software spending. Computer software spending in this context refers to expenditure acquired and paid using FinTech innovations such as mobile money technology, electronic payment platforms, and many others. The next construct used in the study is ICT intensity. ICT intensity is described as the level of use of ICTs in a country. The level of use of any technology in a country can be classified as, non-active (when citizens use no technology at all), low (when citizens use at least one technology), and high (when citizens use more than one technology) (Zhu et al., 2003). The construct is measured by the following indicators, fixed broadband subscriptions, internet users, and active mobile broadband subscriptions. The third construct is ICT regulation which is described as policies, laws, codes of legal ethics, and regulations meant to govern the use of ICTs, and ICT-related services. Indicators from the data used to measure the construct are legal framework adaptability to emerging technologies, and regulatory quality. The fourth construct is socio-economic development which is defined in this study as society's related factors that transform the economic lives of individuals in the society. This dependent construct is measured by the socio-economic gap in the use of digital payments, SDG11 Sustainable Cities and Communities, and SDG3's Good Health and Well Being Labor productivity per employee.

5 Analysis and results

The PLS-SEM approach and the SMART PLS software version 3.3.7 were adopted for the data analysis. The study also used the RStudio software version 1.4.1106-5 to run a NCA to ascertain whether DFI, ICT Intensity, and ICT Regulation were necessary conditions for economic development. The hypotheses underpinning the study were then examined and interpreted following the outcome of the analysis. The interpretation of the results began with an evaluation of the measurement model followed by analyzing an evaluation of the structural model. As per PLS-SEM's rule of thumb, the reliability and validity of the constructs must be attained before the structural model can be evaluated. As such, the measurement model was evaluated to assess the reliability of the indicators, convergent validity, discriminant validity, and internal consistency reliability. The structural model was then evaluated for the relevance of the path coefficients and the model's quality of fit.

5.1 Descriptive statistics

A wide range of explanatory variables is considered to capture various aspects of country characteristics. We verified the basic information about the variables before testing the hypothesis using the assessment given in Table 3. The average values for the socio-economic gap in the use of digital payments and SDG3 Good Health and well-being are greater than those of the other factors. While the standard deviation shows that Fixed broadband subscriptions have the greatest value. The variance inflation factor (VIF) values were used to inspect the correlation between the study variables. The results shown in Table 3 show the absence of multicollinearity among the variables since the

VIF values do not exceed 4. Assessing the structure of data is an important step. It aids in determining where the greatest information is hidden and analyzing outliers and collinearity in a dataset. Datasets with low kurtosis tend to have light tails or lack outliers. The kurtosis and skewness values were used to assess the shape of the data and the detection of outliers in this study. Given that the acceptable values of skewness fall between –3 and + 3, and kurtosis is appropriate from a range of –10 to + 10 when utilizing SEM (Tiberious et al., 2016), we conclude that there are no outliers in the data. Values that fall above or below these ranges are suspect, but SEM is a robust analytical method, so small deviations may not represent major violations of assumptions.

Table 3 Descriptive statistics

	Mean	*Standard deviation*	*Kurtosis*	*Skewness*	*VIF*	*No. of observations used*
Active mobile broadband subscriptions	29.15	16.12	2.07	0.82	2.34	134
Fixed broadband subscriptions	53.51	36.19	–1.53	–0.21	2.44	134
Gender gap in internet use	51.08	20.71	–0.02	–0.82	2.58	134
Internet shopping	27.98	29.51	–0.28	0.91	1.02	134
Internet users	59.92	27.80	–0.95	–0.52	2.27	134
Labour productivity per employee	31.39	25.79	–0.44	0.69	1.29	134
Legal frameworks adaptability to emerging technologies	43.35	22.80	–0.74	0.26	2.74	134
Online access to financial account	34.85	24.87	–0.21	0.70	2.33	134
Regulatory quality	56.01	20.52	–0.51	0.21	2.74	134
SDG11Sustainable Cities and Communities	61.73	24.40	–0.96	–0.25	2.24	134
SDG3 Good Health and well-being	64.50	23.85	–0.33	–0.80	2.11	134
Socioeconomic gap in use of digital payments	65.69	22.99	–0.53	–0.40	2.23	134
Computer software spending	21.33	18.54	1.90	1.29	1.99	134

5.2 *Evaluation of measurement model*

For measurement model evaluation, discriminant validity, item loadings, convergent validity, and internal consistency reliability were evaluated to ensure the reliability and validity of the constructs for suitable inclusion in the path model. The outcome of the indicator loading analysis is shown in Figure 2. To ensure all the indicators measure the constructs satisfactorily, indicator loadings less than the 0.708 thresholds were removed from the final model. In terms of DFI, indicators such as the rural gap in the use of digital payments, and digital inclusion were removed. In the case of ICT regulation, Privacy protection by law content, ICT regulatory environment, and e-commerce legislation for instance were all removed since they did not meet the cut-off point. The level of macroeconomic development/log of GDP per capita was also removed for the socio-economic development latent variable. The remaining items shown in Table 3 met the required threshold and were included in the final model. Following average variance extracted (AVE) for assessing convergent validity, the AVE values for all the latent variables exceeded the 0.5 thresholds. For internal consistency, recommended composite reliability values that are not less than 0.70 were used. Composite reliability values presented in Table 4 indicate the model attained internal consistency reliability.

Table 4 Construct reliability and validity

	Cronbach's alpha	*rho_A*	*Composite reliability*	*Average variance extracted (AVE)*
DFI	0.868	0.902	0.920	0.794
ICT intensity	0.884	0.888	0.928	0.812
ICT regulation	0.887	0.887	0.946	0.898
Socio-economic development	0.902	0.902	0.928	0.720

Discriminant validity is relevant for verifying whether the associations between a reflective construct and its indicators are strong. A satisfactory discriminant validity evaluation demonstrates that a test of concepts is not highly associated with other tests measuring distinct concepts. The Fornell and Larcker (1981) criteria and the study of cross-loadings are the most common techniques for determining discriminant validity in variance-based SEM such as PLS (Hair et al., 2011). The Heterotrait-Monotrait (HTMT) criterion is a preferred choice for checking discriminant validity due to its reliability. The HTMT criterion was employed for validity assessment in this study. Using this criterion, discriminant validity is established if the HTMT value falls below a threshold of 0.90. Inferring from Table 5, the HTMT values fall between 0.409 to 0.813 indicating discriminant validity between the related latent constructs.

Table 5 Discriminant validity (HTMT criterion)

	DFI	*ICT intensity*	*ICT regulation*	*Socio-economic development*
DFI				
ICT Intensity	0.813			
ICT Regulation	0.606	0.480		
Socio-economic development	0.409	0.590	0.739	

The results of the structural model evaluation are shown in Figure 2, Table 6, and Table 7. Following that a significant relationship exists between constructs with a T-value score of 1.65 or beyond (Hair et al., 2019), the results show that four of the five hypotheses were significant. The results revealed that DFI (T = 4.91), and ICT intensity (T = 9.49) have a positive influence on socio-economic development (T = 4.91). DFI (T = 8.80), and ICT intensity (T = 9.49) were again found to have a positive significant influence on ICT regulation. On the contrary, the results show that ICT regulation (T = 1.58) has no significant influence on socio-economic development. The results of the indirect effects reported in Table 7 indicate that ICT regulation does not offer a significant mediation between DFI and Socio-economic development (T = 1.53), nor does it mediate the nexus between ICT Intensity and Socio-economic development (T = 1.54). The f squared values, which explain the sizes of the effects between the constructs, however, indicate that DFI has a medium effect on Socio-economic inclusion (f^2 = 0.136) whereas ICT regulation has little effect on socio-economic development (f^2 =0.019). DFI (f^2 = 0.537), ICT intensity (f^2 = 0.518) were also found to have large effect on ICT regulation. ICT intensity had a large effect on socio-economic development (f^2 = 0.593). From Table 9, it can be inferred that the model explained 83% of socio-economic development and 80% of ICT regulation.

Figure 2 Item loadings (see online version for colours)

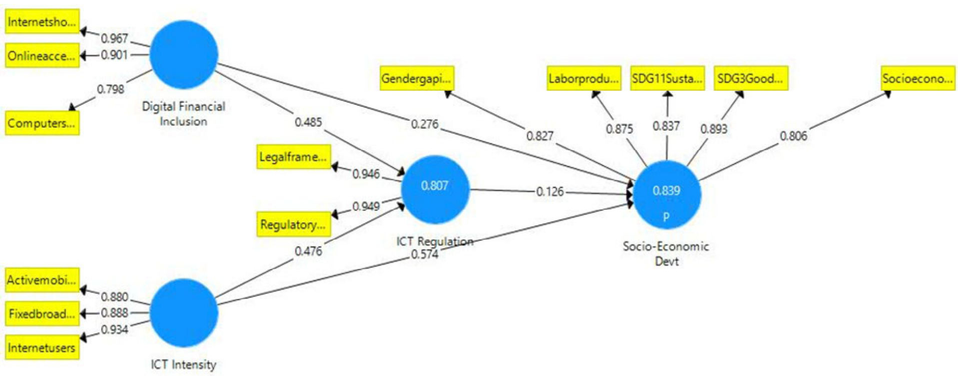


Table 6 Direct hypotheses results

Hypotheses	*Original sample (O)*	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*	*Inference*
DFI -> ICT Regulation	0.48	0.48	0.06	8.80	0.00	Accepted
DFI -> Socio-Economic Development	0.28	0.28	0.06	4.91	0.00	Accepted
ICT Intensity-> ICT Regulation	0.48	0.48	0.05	9.49	0.00	Accepted
ICT Intensity_ -> Socio-Economic Development	0.57	0.58	0.06	9.47	0.00	Accepted
ICT Regulation -> Socio-Economic Development	0.13	0.12	0.08	1.58	0.11	Rejected

Table 7 Indirect effects

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*	*Inference*
DFI -> ICT Regulation -> Socio-Economic Development	0.06	0.06	0.04	1.53	0.13	Rejected
ICT Intensity_ -> ICT Regulation -> Socio-Economic Development	0.06	0.06	0.04	1.54	0.12	Rejected

5.3 *Evaluation of structural model*

Figure 3 Bootstrap results (see online version for colours)

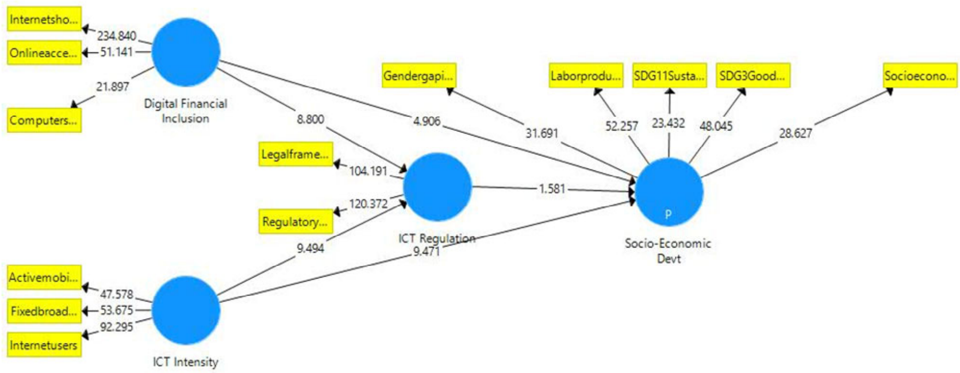


Table 8 F square values

	DFI	*ICT Intensity_*	*ICT regulation*	*Socio-economic development*
DFI			0.537	0.136
ICT Intensity			0.518	0.593
ICT Regulation				0.019
Socio-economic development				

Table 9 R squared

	R square	*R square adjusted*
ICT Regulation	0.807	0.804
Socio-Economic Development	0.839	0.835

5.4 *Necessary condition analysis*

We investigated whether DFI, ICT intensity, and ICT regulation were necessary conditions for socio-economic development after using SmartPLS to analyze the measurement and structural models. The R software was used to conduct the NCA analysis. Tables 10 and 11 present the findings. From Table 10 it can be observed that DFI and ICT intensity are meaningful ($d \geq 0.1$) and significant ($p < 0.05$) necessary conditions for socio-economic development (Adam and Dzang Alhassan, 2021), with ICT intensity being the most necessary condition ($d = 0.259$, $p = 0.000$). Detailed results of the necessary conditions are reported in Table 11. Table 11 highlights that to attain socio-economic development of 40%, two necessary conditions need to be in place, i.e., DFI and ICT intensity should not be less than 5.6% and 6%. Furthermore, to achieve socio-economic development of 80%, DFI, ICT intensity, and ICT regulation should not be less than 44.9%, 50%, and 51.5% respectively. A 100% socio-economic development will be achieved if DFI, ICT intensity, and ICT regulation are not less than 64.5%, 67.5%, and 85.2%, respectively.

Table 10 NCA Effect Sizes

Predicting constructs	*Economic development CR-FDH*	*P-value*
DFI	0.212	0.000
ICT Intensity	0.259	0.000
ICT Regulation	0.215	0.114

Table 11 NCA bottleneck for economic development

Bottleneck economic development	*DFI*	*ICT intensity*	*ICT regulation*
0	NN	NN	NN
10	NN	NN	NN
20	NN	NN	NN
30	NN	6	NN
40	5.6	14.8	NN
50	15.4	23.6	0.8
60	25.2	32.4	17.7
70	35.1	41.2	34.6
80	44.9	50.0	51.5
90	54.7	58.7	68.3
100	64.5	67.5	85.2

6 Discussion

This study was aimed at examining the effects of DFI, and ICT intensity on socio-economic development from a global perspective. The findings show that DFI significantly contributes to socio-economic development. This means that citizens' use and access to DFI including, internet banking, mobile payments, internet shopping, and other financial technologies (FinTech) will improve the socio-economic development of a country. In a nutshell, this finding means that when a country invests in the cost-effective delivery of financial products using technology, this may result in the development of the socio-economic life of the citizens and the country. Based on the findings from the PLS-SEM analysis, DFI is positively associated with socio-economic development. However, the NCA results show that to effectively achieve impactful socio-economic development in a country, at least a 64.5% DFI level is necessary. This means that to obtain full socio-economic status in a country, more than 60% of the underserved citizens must have access to devices, FinTech innovative platforms, and participate in digital financial services. This finding is supported by Ahmad et al., (2021, p.306) who postulated that "DFI provides low and affordable financial services that alleviate people's vulnerability by improving their living norms". This finding contributes to the ongoing World Bank discussion on the endorsement of financial inclusion as a viable strategy for alleviating poverty in developing and impoverished nations (Khera et al., 2021).

Similarly, the findings show that ICT Intensity significantly influences socio-economic development. Our findings are consistent with those of Alderete (2017), who discovered that ICT intensity, use, and skills have a beneficial impact on socio-economic development by boosting productivity, and employment. Palvia et al. (2017) also reported the positive influential nexus between ICTs and socio-economic development in under-developed nations. ICT intensity plays a crucial role in obtaining socio-economic development is supported by the NCA, which confirms that without ICT intensity, socio-economic development will not be successful. In other words, over 67.5% of citizens must be using the necessary ICTs to achieve full socio-economic level. The findings stress the relevant level of ICT usage that could trigger socio-economic development. For countries with low ICT intensity rate, encouraging the use of technological innovation in the financial landscape could be promising.

Findings from this study also reveal that ICT regulation does not influence socio-economic development. This means that a country's ICT-related legal frameworks and government policies may not significantly contribute to socio-economic development. However, relying on the NCA results indicate that to obtain a full or satisfactory socio-economic development status as a country, at least an 85.2% level of ICT regulation is required. This means that more than 80% of the ICTs used in a country must be regulated to achieve a full socio-economic status. Furthermore, the hypothesis that ICT intensity has a significant influence on ICT regulation was also supported. These findings mean that the level of a country's ICT adoption may offer grounds for the implementation of cyber laws, and regulatory policies to guard the online security of users. The findings heighten calls for individual users to gather effective digital skills, training, and education on the prudent use of ICTs to mitigate the high rates of invasion of privacy and security online.

The hypothesis that DFI positively influences ICT regulation was supported. This indicates that the increased access and use of financial services by underserved populations through digital technologies will trigger the need to advance ICT policies, laws, and regulatory bodies to safeguard the privacy, monetary assets, digital records, and electronic transactions of users. In a nutshell, if underprivileged groups in a nation are increasingly using digital financial services, regulatory bodies are expected to enforce ICT-related rules that enable effective use of ICTs and reduce the associated dangers. The study found that ICT regulation does not significantly mediate the link between DFI and socio-economic development. These findings show that the existence of ICT regulations/laws does not have an indirect influence on the level of underserved populations' use of DFS and thus, does not obstruct their socio-economic development. Again, ICT regulation was found to have no significant mediation between the association of ICT intensity and socio-economic development. This means that ICT regulation does not have an indirect effect on citizens' level of ICT usage and will not hinder their socio-economic development. Except for poor nations, the findings may hold for developed countries, particularly those with extensive technical infrastructure, and therefore the introduction of ICT regulations may not necessarily have a detrimental influence on their ICT intensity, DFI, and socioeconomic development.

6.1 Implications for theory, practice and policy

The findings from our study have some implications for theory, practice, and policy. For theory, this study builds a theoretical framework to specifically identify the level of DFI, ICT regulation, and ICT usage that is required for a country to attain socio-economic development through a multi-analytical approach. This framework is an extension and adaptation of Roztocki et al.'s (2019) "multi-dimensional framework for the role of ICT in socio-economic development". By adopting concepts of this framework and combining PLS-SEM and NCA, we offer global insights into the discourse and highlight theoretically the critical success factors in ICT4D (ICT for development) initiatives. The framework also advances the literature on digital inclusion through theoretical viewpoints by revealing how ICTs, particularly FinTechs for underserved populations might impact a country's socio-economic development. The findings can offer insights into the ongoing works on financial inclusion as a viable tool for alleviating poverty in developing and impoverished nations (Khera et al., 2021) by making known the level of necessary conditions required. For practice, the findings draw awareness for stakeholders such as NGOs, private corporations, and governments on the level of ICT-based factors that contribute or do not contribute to a country's socio-economic development to make better use of their limited resources. Using the NCA technique, we were able to identify the actual conditions that need to be satisfied for a certain outcome to occur. Government policymakers, development partners, and service providers may find such information useful, as it may serve as a guideline for program development. For instance, the findings reveal that a country may achieve a full or satisfactory socio-economic status if the level of the country's DFI, ICT intensity, and ICT regulation is not less than 64.5%, 67.5%, and 85.2%, respectively. Knowledge on this may inform government policymakers of the minimal level of ICT resources that needs to be invested in the economy to contribute to the country's socio-economic development.

7 Conclusions

This research investigated the effects of DFI, and ICT intensity on Socio-Economic Development from a global perspective through a multidimensional analytical approach. The novelty of this study stems from it being the first to establish the required level of factors necessary for socio-economic development and adopt a multi-analytical approach and global dataset to investigate the association between DFI and socio-economic development. Both the NCA and PLS-SEM results indicate that ICT regulation has no significant influence on the socio-economic development of a country. DFI and ICT intensity positively influence socio-economic development based on the results from the PLS-SEM analysis. The results from the NCA also identify ICT intensity and DFI as necessary conditions for a country's socio-economic development. The study also analyzed the mediating effects of ICT regulation in driving DFI and ICT intensity toward the socio-economic development of citizens. The results found that ICT regulation does not mediate the association between DFI and socio-economic development. The mediating effect of ICT regulation on the association between ICT intensity and socio-economic development was also not supported. Considering the complexity of obtaining a cross-country dataset, our study is limited to a dataset from a single secondary source (i.e., Network Readiness Index). Despite this, the indices' trustworthiness is incontestable, as they were developed by credible and approved organizations using appropriate statistical processes. Future research may focus on comparing the results of primary data and other constructs we could not capture in this study.

References

Adam, I.O. and Dzang Alhassan, M. (2021) 'The mediating role of ICT regulation on the effects of ICT access and ICT use on e-participation: evidence from structural equation modelling and necessary condition analysis', *African Journal of Science, Technology, Innovation and Development*, Vol. 0, No. 0, pp.1–12, https://doi.org/10.1080/20421338.2021.1937815.

Ahmad, M., Majeed, A., Khan, M.A., Sohaib, M. and Shehzad, K. (2021) 'Digital financial inclusion and economic growth: provincial data analysis of China', *China Economic Journal*, Vol. 14, No. 3, pp.291–310, https://doi.org/10.1080/17538963.2021.1882064.

Akpaku, E. (2022) 'The antecedents to the actual use of digital currencies in Ghana', *International Journal of ICT Research in Africa and the Middle East*, Vol. 10, No. 2, pp.0–4, https://doi.org/10.4018/IJICTRAME.290838.

Alderete, M.V. (2017) 'Information technology for development examining the ICT access effect on socioeconomic development : the moderating role of ICT use and skills', *Information Technology for Development*, Vol. 0, No. 0, pp.1–17, https://doi.org/10.1080/02681102.2016.1238807.

Alhassan, M.D. and Adam, I.O. (2021) 'The effects of digital inclusion and ICT access on the quality of life: a global perspective', *Technology in Society*, September, Vol. 64, p.101511, https://doi.org/10.1016/j.techsoc.2020.101511.

Aziz, A. and Naima, U. (2021) 'Rethinking digital financial inclusion: Evidence from Bangladesh', *Technology in Society*, October, Vol. 64, https://doi.org/10.1016/j.techsoc.2020.101509.

Bhattarai, R., Pappel, I., Vainsalu, H., Yahia, S.B. and Draheim, D. (2019) 'The impact of the single digital gateway regulation from the citizens' perspective', *Procedia Computer Science*, Vol. 164, pp.159–167, https://doi.org/10.1016/j.procs.2019.12.168.

Chikondi Daka, G. and Phiri, J. (2019) 'Factors driving the adoption of e-banking services based on the UTAUT model', *International Journal of Business and Management*, Vol. 14, No. 6, p.43, https://doi.org/10.5539/ijbm.v14n6p43.

Dul, J. (2016) 'Necessary condition analysis (NCA): logic and methodology of 'necessary but not sufficient' causality', *Organizational Research Methods*, Vol. 19, No. 1, pp.10–52, https://doi.org/10.1177/1094428115584005.

Dutta, S. and Lanvin, B. (2020) *The Network Readiness Index 2020*, Vol. 2020, No. 2.

Eton, M., Mwosi, F., Okello-Obura, C., Turyehebwa, A. and Uwonda, G. (2021) 'Financial inclusion and the growth of small medium enterprises in Uganda: empirical evidence from selected districts in Lango sub-region', *Journal of Innovation and Entrepreneurship*, Vol. 10, No. 1, https://doi.org/10.1186/s13731-021-00168-2.

Fernandes, C., Borges, M.R. and Caiado, J. (2021) 'The contribution of digital financial services to financial inclusion in Mozambique: an ARDL model approach', *Applied Economics*, Vol. 53, No. 3, pp.400–409, https://doi.org/10.1080/00036846.2020.1808177.

Fornell, C. and Larcker, D.F. (1981) 'Evaluating structural equation models with unobservable variables and measurement error', *Journal of Marketing Research*, Vol. 18, No. 1, pp.39–50.

Hair, J.F., Ringle, C.M. and Sarstedt, M. (2011) 'PLS-SEM: indeed a silver bullet', *Journal of Marketing Theory and Practice*, Vol. 19, No. 2, pp.139–152, https://doi.org/10.2753/MTP1069-6679190202.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019) 'When to use and how to report the results of PLS-SEM', *European Business Review*, Vol. 31, No. 1, pp.2–24, https://doi.org/10.1108/EBR-11-2018-0203.

Hawthorne, R. and Grzybowski, L. (2021) 'Distribution of the benefits of regulation vs. competition: The case of mobile telephony in South Africa', *International Journal of Industrial Organization*, Vol. 74, p.102673, https://doi.org/10.1016/j.ijindorg.2020.102673.

Khera, P., Ng, S., Ogawa, S. and Sahay, R. (2021) *Is Digital Financial Inclusion Unlocking Growth?*, International Monetary Fund.

Kim, M., Zoo, H., Lee, H. and Kang, J. (2018) 'Mobile financial services, financial inclusion, and development: a ystematic review of academic literature', *Electronic Journal of Information Systems in Developing Countries*, Vol. 84, No. 5, pp.1–17, https://doi.org/10.1002/isd2.12044.

Lechman, E. and Popowska, M. (2022) 'Harnessing digital technologies for poverty reduction. Evidence for low-income and lower-middle income countries', *Telecommunications Policy*, Vol. 46, No. 6, p.102313, https://doi.org/10.1016/j.telpol.2022.102313.

Lefophane, M.H. and Kalaba, M. (2021) 'Estimating effects of ICT intensity on productivity, employment and output in South Africa: an industry-level analysis', *Information Technology for Development*, Vol. 0, No. 0, pp.1–26, https://doi.org/10.1080/02681102.2021.1882367.

Mayer, W., Madden, G. and Wu, C. (2020) 'Broadband and economic growth: a reassessment', *Information Technology for Development*, Vol. 26, No. 1, pp.128–145, https://doi.org/10.1080/02681102.2019.1586631.

Mhlanga, D. (2020) 'Industry 4.0 in finance: the impact of artificial intelligence (AI) on digital financial inclusion', *International Journal of Financial Studies*, Vol. 8, No. 3, pp.1–14, https://doi.org/10.3390/ijfs8030045.

Mignamissi, D. and Djijo T.A.J. (2021) 'Digital divide and financial development in Africa', *Telecommunications Policy*, Vol. 45, No. 9, https://doi.org/10.1016/j.telpol.2021.102199.

Mouna, A. and Jarboui, A. (2021) 'Understanding the link between government cashless policy, digital financial services and socio-demographic characteristics in the MENA countries.', *International Journal of Sociology and Social Policy*, https://doi.org/10.1108/IJSSP-12-2020-0544.

Mushtaq, R. and Bruneau, C. (2019) 'Microfinance, financial inclusion and ICT: implications for poverty and inequality', *Technology in Society*, Vol. 59, pp.106–112, https://doi.org /10.1016/j.techsoc.2019.101154.

Nedungadi, P.P., Menon, R., Gutjahr, G., Erickson, L. and Raman, R. (2018) 'Towards an inclusive digital literacy framework for digital India', *Education and Training*, Vol. 60, No. 6, pp.516–528, https://doi.org/10.1108/ET-03-2018-0061.

Ozili, P.K. (2018) 'Impact of digital finance on financial inclusion and stability', *Borsa Istanbul Review*, Vol. 18, No. 4, pp.329–340, https://doi.org/10.1016/j.bir.2017.12.003.

Palvia, P., Baqir, N. and Nemati, H. (2017) 'ICT for socio-economic development: a citizens' perspective', *Information & Management*, https://doi.org/10.1016/j.im.2017.05.003.

Pappel, I., Tsap, V. and Draheim, D. (2021) 'The e-LocGov model for introducing e-governance into local governments: an Estonian case study', *IEEE Transactions on Emerging Topics in Computing*, Vol. 9, No. 2, pp.597–611, https://doi.org/10.1109/TETC.2019.2910199.

Peric, K. (2015) 'Editorial digital financial inclusion', *Journal o f Payments Strategy & Systems*, Vol. 9, No. 3, pp.212–214.

Pradhan, R.P. and Sahoo, P.P. (2021) 'Are there links between financial inclusion, mobile telephony, and economic growth? Evidence from Indian states', *Applied Economics Letters*, Vol. 28, No. 4, pp.310–314, https://doi.org/10.1080/13504851.2020.1752893.

Pradhan, R.P., Arvin, M.B., Nair, M.S., Hall, J.H. and Bennett, S.E. (2021) 'Sustainable economic development in India: the dynamics between financial inclusion, ICT development, and economic growth', *Technological Forecasting and Social Change*, March, Vol. 169, p.120758, https://doi.org/10.1016/j.techfore.2021.120758.

Roztocki, N., Soja, P. and Weistroffer, H.R. (2019) 'The role of information and communication technologies in socioeconomic development: towards a multi-dimensional framework', *Information Technology for Development*, Vol. 25, No. 2, pp.171–183, https://doi.org /10.1080/02681102.2019.1596654.

Senyo, P.K., Osabutey, E.L.C. and Seny Kan, K.A. (2021) 'Pathways to improving financial inclusion through mobile money: a fuzzy set qualitative comparative analysis', *Information Technology and People*, Vol. 34, No. 7, pp.1997–2017, https://doi.org/10.1108/ITP-06-2020-0418.

Sethi, D. and Acharya, D. (2018) 'Financial inclusion and economic growth linkage: some cross country evidence', *Journal of Financial Economic Policy*, Vol. 10, No. 3, pp.369–385, https://doi.org/10.1108/JFEP-11-2016-0073.

Soekarno, S. and Setiawati, M. (2020) 'Women and digital financial inclusion in Indonesia as emerging market', *International Review of Management and Marketing*, Vol. 10, No. 5, pp.46–49, https://doi.org/10.32479/irmm.10212.

Soriano, M.A. (2017) 'Factors driving financial inclusion and financial performance in Fintech new ventures: an empirical study', p.258.

Tiberious, M., Mwania, J.M. and Mwinzi, J. (2016) 'The influence of financial resources on the integration of the national goals of education', *International Journal of Education and Research*, Vol. 4, No. 9, pp.51–62.

Wang, X. and He, G. (2020) 'Digital financial inclusion and farmers' vulnerability to poverty: evidence from rural China', *Sustainability*, Vol. 12, No. 4, Switzerland, https://doi.org/10.3390/su12041668.

Zhu, K., Kraemer, K. and Xu, S. (2003) 'Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors', *European Journal of Information Systems*, Vol. 12, No. 4, pp.251–268, https://doi.org/10.1057/palgrave.ejis.3000475.

Appendix

List of countries

Albania	Denmark	Kyrgyzstan	Qatar
Algeria	Dominican Republic	Lao PDR	Romania
Angola	Ecuador	Latvia	Russian Federation
Argentina	Egypt	Lebanon	Rwanda
Armenia	El Salvador	Lesotho	Saudi Arabia
Australia	Estonia	Lithuania	Senegal
Austria	Eswatini	Luxembourg	Serbia
Azerbaijan	Ethiopia	Madagascar	Singapore
Bahrain	Finland	Malawi	Slovakia
Bangladesh	France	Malaysia	Slovenia
Belarus	Gambia	Mali	South Africa
Belgium	Georgia	Malta	Spain
Benin	Germany	Mauritius	Sri Lanka
Bolivia	Ghana	Mexico	Sweden
Bosnia & Herzegovina	Greece	Moldova	Switzerland
Botswana	Guatemala	Mongolia	Tajikistan
Brazil	Guinea	Montenegro	Tanzania
Bulgaria	Honduras	Morocco	Thailand
Burkina Faso	Hong Kong (China)	Mozambique	Trinidad and Tobago
Burundi	Hungary	Namibia	Tunisia
Cabo Verde	Iceland	Nepal	Turkey
Cambodia	India	Netherlands	Uganda
Cameroon	Indonesia	New Zealand	Ukraine
Canada	Iran, Islamic Rep.	Nigeria	United Arab Emirates
Chad	Ireland	North Macedonia	United Kingdom
Chile	Israel	Norway	United States
China	Italy	Oman	Uruguay
Colombia	Jamaica	Pakistan	Venezuela
Congo, Dem. Rep.	Japan	Panama	Viet Nam
Costa Rica	Jordan	Paraguay	Yemen
Côte d'Ivoire	Kazakhstan	Peru	Zambia
Croatia	Kenya	Philippines	Zimbabwe
Cyprus	Korea, Rep.	Poland	
Czech Republic	Kuwait	Portugal	