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Competitiveness, Change Readiness, and ICT Development: An empirical investigation of TOE framework for Poverty Alleviation

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Abstract. The Sustainable Development Goal (SDG) 1 – ‘No Poverty’ is one of the ambitious goals of all nations across the globe. Multiple factors lead to poverty in a nation. Hence, the alleviation of poverty requires governments to address these multiple factors at various levels of society. This study is an attempt to understand a few factors that can help poverty alleviation. Many theoretical studies provide different frameworks for poverty alleviation but a dearth of studies that empirically shows that poverty alleviation is possible. This study is an empirical investigation that looks into the macro-level factors that could help alleviate poverty through the lens of the Technology-Organization-Environment (TOE) framework. It underscores the mediating role of ICT development of the nations that change-ready and are competitive enough to address poverty at the grass-root level and thus strive for achieving the SDG goal 1. The results strengthen our argument that nations that are competitive and change-ready using ICT development measures could address the problem of poverty.

Keywords: Competitiveness Index, Change Readiness Index, ICT Development, Poverty alleviation, TOE framework, SDGs

1 Introduction

"ICTs alone cannot improve peoples' lives; the use of ICTs needs to occur within broader strategies that are tailored to make the most use of these tools and techniques to reap their potential benefits for human development" [1]

Since the use of Information Communication Technologies (ICTs), the societal and economic structures have undergone drastic changes [2]. The unique strengths of ICTs have drawn great attention to overcome the drawbacks of conventional systems thus becoming the fundamental pillar of the knowledge economy [3]. This engendered ICTs to take on a predominant role in shaping the economies of the nations around the globe, providing a vital source for competitiveness thus leading to great attention in management Literature [4].

Informatization of the society and level of ICT knowledge are the two main drivers of improvement in human activities that lead to economic growth [5] and thus helping nations in poverty alleviation [6]. Though the role of ICTs in poverty alleviation is a much debatable topic, its role as a fundamental pillar of knowledge economy empowers people that creates a spirit of competition. ICTs can help reduce poverty by improving poor people's access to education, healthcare, and various governments' financial initiatives [7]. Though low-cost ICT infrastructure is a necessary condition for the successful use of ICT by the poor, it is not sufficient. The implementation of ICT projects plays a prominent role in defining the success of poverty alleviation. Thus, nations promoting ICT development in poverty alleviation should consider various critical success factors [7].

Multiple studies looked into the SDG 1 i.e., poverty alleviation (no poverty), through various lens such as policy changes [8], [9], [10]; labor migration and poverty alleviation [11]; micro-financial services [12]; micro-enterprises [13]; technology and poverty [14]; integrated information ecosystems [15]. These studies provided useful insights on poverty alleviation and the contribution of various factors to the alleviate problem of poverty.

This study employs the TOE framework to propose factors that help achieve the Sustainable Development Goal 1 – No Poverty (Poverty Alleviation) and thus claim to make the following contributions. The study employs the TOE framework that underscores the importance of ICT development of a nation to alleviate poverty. It also empirically tests the mediating role of ICT development in alleviating poverty through competitiveness and change readiness. It adds rigor and robustness to the TOE framework by testing it empirically. Thus the research questions of this study addresses are as follows:

RQ1: What are a few factors that help a nation in poverty alleviation?

RQ2: Does ICT Development of a nation help in poverty alleviation?

2 Literature & Theoretical framework

2.1 Literature

There is no universal definition for *poverty* although most scholars consider income as a proxy for poverty. As per this definition, any person whose income is below the poverty line is considered as poor [16]. Most recent studies have argued that poverty is a multidimensional concept that includes the dimensions of social, economic, political, and cultural as well. Castro, M. C., [17] defines poverty as “a multidimensional phenomenon and it refers to a pronounced deprivation in one or more facets of the well-being of a person.” Along with the non-availability of abundant natural resources, proper infrastructure, and income opportunities, there are many other reasons for poverty to exist. Of them stand out the unequal access to basic amenities such as healthcare, education, sanitation facilities, clean drinking water, justice, and political protection. This results from poorly developed strategies and government policies [12]. Sachs, J.D., [18] points out that an absolute resolute effort is required by both developing as well as developed nations to achieve ending global poverty by 2025 with a global compact that

designated the shared equal responsibilities by both parties. He suggests a differential diagnosis that stresses to abandon a 'one size fit all' approach usually followed by internationally renowned agencies like of World Bank and IMF and formulate strategies that tailor the economies of the nations as per their own need and pace. On these grounds, the United Nations with its Sustainable Development Goals (SDGs) has created a framework that helps countries across the globe to put efforts to attain development in all aspects.

The SDGs agenda for 2030 is to take up multiple challenges that the countries face such as extreme poverty, access to education, poor healthcare, unemployment and ensure them of economic prosperity, social well-being, and environmental protection [8]. They provide nations with a multidimensional and holistic vista on development in contrast to the conventional development agendas that drive basis on a limited set of dimensions [12]. Among the 17 SDGs "*Ending Poverty and expanding social protection coverage*" is the number one goal that is of importance [19]. Dugarova, E., [20] argues that the SDGs are of great importance to developing nations when compared developed as there has been a lot of progress achieved in terms of eradicating poverty, increase life-expectancy, and near-universal access to primary education in developed nations. Hence, the SDGs present them with a substantial opportunity to scale up what has been worked so far and address existing and emerging challenges [20].

It was during the late seventies where the concept of "information society" has been introduced with the advent of the latest technologies that were widely used for communications called as information and communication technologies (ICTs). Since then many scholars have acknowledged the close relationship between access to information and poverty. These are the main propositions that were proposed by [14]:

- "information leads to resources;
- information leads to opportunities that generate resources;
- access to information leads to access to resources; and
- access to information leads to access to opportunities that generate resources."

Flor, A.G., [14] further explored the relationship between poverty and ICTs which posits that a person who is 'information-poor' is also 'resource-poor'. In a report prepared by Batchelor, S. et al., [21] it's being argued that ICTs provide a platform to share information across different barriers and bridge the gap between stakeholders that gives voice to many underprivileged people that enhances their lives in economic, health and educational activities. ICTs potential to deal with the challenges related to information, communication, and knowledge dimensions caused a high degree of excitement during the past two decades [22].

Sen, A., [23] & Adera, EO., et al., [24] opines that mere access to and deployment [25] of ICTs is not enough but how people are using it to reduce poverty is important. The World Bank [26] had proposed a strategy consisting of three ways to attack poverty using ICTs: "*promoting opportunity, facilitating empowerment, and enhancing security*". Although the results of this strategy are yet to come to the light [7]. Two approaches have been identified when considering the use of ICTs for poverty reduction. They are the demand side and the supply side driven approaches. In demand-driven

approaches, the poor stands at the center whereas in supply-driven approaches the focus is on the technology supply, access, and connectivity [16]. Many factors are linked to the benefits of ICTs in poverty alleviation such as ICTs integration at the policy to achieve goals at an individual, community, and societal level. It is equally important to have support mechanisms in place to encourage and motivate poor people who are using ICTs to overcome the fear of technology.

2.2 Theoretical framework

Technology Organization Environment (TOE) framework.

The authors have used the TOE [27] framework as a theoretical lens to understand the impact of these factors on Poverty Alleviation. It is a well-marked theory that has strong theoretical and empirical support with a robust theoretical base [28]. The TOE framework has been used in multiple studies with the organizational context of innovative technologies adoption [29], [30]. But to the best of the knowledge of authors, this study is the first of its kind to apply an organizational level theory to a country-level context. The TOE framework has three elements that influence a firm's adoption decisions [29]. They are the technology context, organizational context, and the environmental context. The detailed explanation of these three contexts along with the operationalization of the factors to this study has been provided below. The authors posit that the factors determining the alleviation of poverty can be divided into three contextual categories, broadly, although the framework does not provide any additional information about what these factors are [31].

Technology Context.

At an organization level, technology refers to all the technologies that are pertinent to the organization – both in use and are available in the marketplace that is not used [29]. The authors have used the dimensions ICT Access, ICT Use & ICT Skills from the ICT Development Index (IDI). IDI is a report that is published based on internationally agreed information and communication technologies (ICT) indicators annually by the United Nations International Telecommunication Union (ITU). The use of ICT Access, Use, and Skill seemed appropriate in the context of a nation with the studies done by [28], [32], & [33]. IDI is a complex measure with 11 indicators that measure: the evolution and level of ICT development in countries; the digital divide; progress in ICT development in both developing and developed nations; and the potential of ICTs to the extent countries can benefit to complement development and growth [34]. A country's evolution process to become an 'information society' can be achieved in three stages: ICT readiness (ICT access); ICT intensity (ICT Use); and ICT impact (ICT Skills).

Organization Context.

Baker, J. [29] defines organization context as the resources and the characteristics of the firm that include the intra-firm communication process, linking structures between

employees, firm size, and the number of resources. The authors have used the dimensions from the Global Competitive Index (GCI). GCI reports are published annually by [35]. Echoing with resources and characteristics of a firm, a nation's resources and characteristics resembles the dimensions of GCI. The dimensions used for this study are Enabling Environment, Human Capital, Markets, and Innovation Ecosystem. The dimensions used for this study in the context of a nation are in line with the factors of organizational context by the studies done by [36]; [37] & [33].

The GCI measures these four dimensions of a nation using 12 pillars with 98 indicators [35]. We live in a world that is experiencing the 4th Industrial Revolution (4IR) and technologies are shaping and changing every aspect of human life. With this background, the governments of every nation have a burning question that needs to be answered with integrity – How to sustain the growth with the growing technological advancements? This is where the GCI would provide an answer to the nations. It provides a holistic view of the nations on the pillars that are sustaining growth.

H1a: Enabling Environment of a nation is positively associated with the Poverty Alleviation of the nation.

H1b: Enabling Environment of a nation is positively associated with the ICT Development of the nation.

H2a: Human Capital of a nation is positively associated with the Poverty Alleviation of the nation.

H2b: Human Capital of a nation is positively associated with the ICT Development of the nation.

H3a: Markets of a nation is positively associated with the Poverty Alleviation of the nation.

H3b: Markets of a nation is positively associated with the ICT Development of the nation.

H4a: Innovative Environment of a nation is positively associated with the Poverty Alleviation of the nation.

H4b: Innovative Environment of a nation is positively associated with the ICT Development of the nation.

Environment context.

The environment context comprises the presence or absence of the technology providers, the structure of the industry, and the regulatory environment [29]. The authors have made use of the dimensions from the Change Readiness Index (CRI) published once in two years by [38]. The dimensions used for this study are Enterprise Capability; Government Capability; and People & Civil Society. The three dimensions adopted from the CRI used for this study seemed appropriate with the factors that were found in the studies conducted by [32] & [33]. Hence, the authors have employed them as proxies for environment providers of a nation.

The Change Readiness Index comprises three dimensions measured using 30 indicators that represent regulatory environment controlled by nations' governments, enterprise capabilities that consist of labor markets, economic diversification & openness, etc., and finally people and civil society dimension that includes demographic variables.

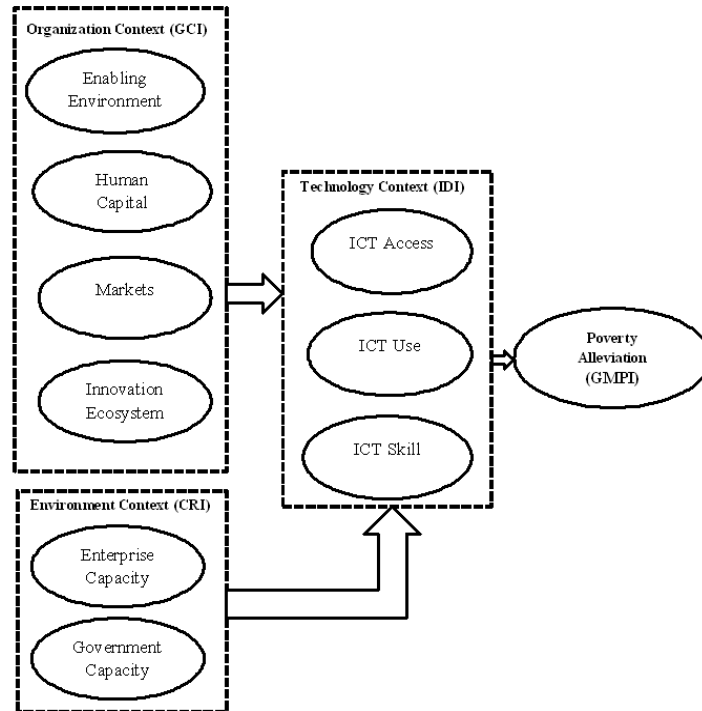
H5a: Change Readiness of a nation is positively associated with Poverty alleviation of the nation

H5b: Change Readiness of a nation is positively associated with the ICT Development of the nation.

Poverty Alleviation: Definition.

The dependent variable of the study is Poverty Alleviation which is being operationalized using measures adapted from the Global Multidimensional Poverty Index (GMPI) [39]. The GMPI report is published by the United Nations Development Programme and the Oxford Poverty & Human Development Initiative (OPHI) annually, with the cumulative poverty measurements. This is a much comprehensive Index when compared to Human Development Index (HDI) that replaced HDI from 2010. The GMPI comprises three main dimensions: Health; Education and Standard of Living.

Fig. 1. Proposed Research Model



H6: ICT Development of a nation is positively associated with the Poverty Alleviation of the nation.

3 Methodology

3.1 Data

The study makes use of the secondary data available for 65 countries from the various indices like ICT Development Index (IDI) for the year 2018; Global Multidimensional Poverty Index (GMPI) for the year 2019; the Global Competitiveness Index (GCI for the year 2018 and the Change Readiness Index (CRI) for the year 2017. The study employs Structural Equation Modelling (SEM) to perform a cross-sectional analysis of the data. When compared to other multivariate techniques the use of SEM has several advantages in the current context. Its ability to allow correcting measurement errors gives the researcher the flexibility and freedom to explore different possible model outcomes. Also, in the current study, it is required to analyze the mediating role of IDI on Poverty alleviation which can be done using SEM that can assess direct and indirect effects [40]. The dependent variable Poverty Alleviation's (GMPI) data is from the latest the year 2019 and the remaining follows the previous years' to account for a lag of one to two years for the effect of technology and other institutional changes to take place. The data for GCI and IDI dimesons is of the year 2018, and the data for CRI is of 2017. Though the data for CRI in the year 2019 is available, it is not considered for analysis since the dependent variable's data is of 2019. Since the data is published by reputed international organizations, it is assumed that the measures are reliable and are free from method biases.

3.2 Analysis

Measurement Model.

The model fitness indices are presented in Table 1. The CMIN of the measurement model is 141.520 with df as 70. The CMIN/df ratio is 2.022 which is excellent well under the acceptable upper value 3 [41]. Both CFI = 0.918 and SRMR = 0.10 are in acceptable range [42]. However, the RMSEA measure is 0.126 which should be less than 0.06 [43]. One of the reasons could be the very low sample size [42]. Unlike working with primary data, formulating measurement models with secondary data could be tricky given the limitations on data availability.

Path Analysis: SEM (reduced model).

Through path analysis the direct effect of independent variables on the dependent variable is analyzed. Here the effect of GCI dimensions and Change Readiness index were analyzed on poverty alleviation. The results of the model are presented in Table 2.

Table 1. Model Fit Measures

Measure	Estimate	Threshold	Interpretation
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CMIN	141.520	--	--
DF	70.000	--	--
CMIN/DF	2.022	Between 1 and 3	Excellent
CFI	0.918	>0.95	Acceptable
SRMR	0.100	<0.08	Acceptable
RMSEA	0.126	<0.06	Terrible
PClose	0.000	>0.05	Not Estimated

Table 2. Reduced Model – Hypotheses testing

	Estimate	S.E.	C.R.	P	Hypotheses
PA <-- CRI (H5b)	0.068	0.059	1.157	0.247	Not Supported
PA <-- GC_HC (H2b)	0.016	0.163	0.1	0.921	Not Supported
PA <-- GC_EE (H1b)	0.821	0.144	5.696	***	Supported
PA <-- GC_M (H3b)	-1.233	0.328	-3.754	***	Supported
PA <-- GC_IE (H4b)	0.48	0.275	1.745	0.081	Not Supported

Mediation Analysis.

Table 3 presents the results of the mediation model. This tests the effect of IDI as a mediator for CRI and GCI dimensions.

Table 3. Mediation Model – Hypotheses testing

	Estimate	S.E.	C.R.	p-value	Hypotheses
IDI <-- GC_HC	0.039	0.01	3.823	***	Supported
IDI <-- GC_M	-0.057	0.019	-2.975	0.003	Supported
IDI <-- GC_EE	0.09	0.009	10.124	***	Supported
IDI <-- GC_IE	-0.021	0.016	-1.268	0.205	Not Supported
IDI <-- CRI	-0.007	0.004	-1.934	0.053	Not Supported
PA <-- IDI	5.258	1.214	4.331	***	Supported

4 Results and Discussion

Table 2 presents the hypotheses testing results from the path analysis SEM without any mediation effect of ICT development on Poverty Alleviation. The results show that only hypotheses Enabling Environment and Markets dimensions with Poverty alleviation are supported. This infers that there is not much direct relationship of other dimensions

such as Human Capital, Innovative Environment, and CRI independently does not affect poverty alleviation. Thus, the mediation analysis with ICT Development is justified with these results. Table 3 presents the hypotheses testing results for the mediation analysis. Except for Innovation Environment and CRI, all other hypotheses were supported showing that there is a mediating effect of ICT Development to alleviate poverty.

Table 4. Standardized Total, Direct and Indirect Effects

Standardized Total Effects (Group number 1 - Default model)							
	CRI	GC_IE	GC_M	GC_HC	GC_EE	IDI	PA
IDI	- 0.125	-0.155	-0.229	0.336	0.824	0	0
PA	- 0.061	-0.076	-0.112	0.164	0.403	0.489	0
Standardized Direct Effects (Group number 1 - Default model)							
	CRI	GC_IE	GC_M	GC_HC	GC_EE	IDI	PA
IDI	- 0.125	-0.155	-0.229	0.336	0.824	0	0
PA	0	0	0	0	0	0.489	0
Standardized Indirect Effects (Group number 1 - Default model)							
	CRI	GC_IE	GC_M	GC_HC	GC_EE	IDI	PA
IDI	0	0	0	0	0	0	0
PA	- 0.061	-0.076	-0.112	0.164	0.403	0	0

Furthermore, Table 4 presents the standardized total, direct and indirect effects path coefficients. The results show a clear meditation effect by ICT Development that exists between Competitiveness, Change Readiness, and Poverty Alleviation.

5 Conclusion, Limitations, and Future Research

The role of ICT Development in alleviating poverty has been studied with factors such as competitiveness and change readiness. ICT mediates the relationship between competitiveness – poverty alleviation and changes readiness – poverty alleviation. This is done using secondary data available from various indices for the years 2017 (CRI), 2018 (GCI & IDI), and 2019 (GMPI). A cross-sectional analysis was done using Structural Equation Modelling to understand the mediating role of ICT development of nations on poverty alleviation. ICT development has found to be playing a statistically significant role in alleviating poverty in the given sample of nations. Though there are some direct effects large part of them remain insignificant stressing the importance of ICT development.

The study makes a decent contribution to the literature by employing the TOE framework for understanding the role of ICT development. Though numerous studies used the TOE framework earlier, none of those looked into the aspect of Poverty alleviation.

It also provides an empirical test for the TOE framework that further strengthens the robustness of the framework. Further, it acts as a signpost to the policymakers and governments of nations to understand the importance of ICT development and also stress equally on other dimensions that emerged from this study.

Since no study is without limitations, certain aspects could have provided better insights into this study. First, the study used data for only 65 countries because of the unavailability of data. This would prove to be an important future research agenda to acquire data from as many countries as possible so that the message would become strong to the nations revealing the importance of ICT development. Second, due to the low sample size, few model fit measures (particularly RMSEA) did not fall within an acceptable range which questions the framework. This could be addressed again with more number of countries being included in the study. Future research could also take into account the innovation capabilities (GII) of a nation that might help alleviate poverty. Third, the study used cross-sectional data for analysis. Future research could use panel data on the proposed framework to test the hypotheses. Fourth, our study employed secondary data available for the factors of Technology, Organization, and Environment. Because of the data unavailability, we have missed out on the latest ICT' such as Block chain, AI, Machine Learning, etc., Future studies could incorporate data on these ICTs to understand their impact on development. Overall, the study attempted to understand a few factors that could help poverty alleviation. Though, not exhaustive, the nations can work on these factors rigorously to achieve the Sustainable Development goal of 'No Poverty' by 2030.

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