

Article

Asymmetric nexus between telecommunications infrastructure, institutions and poverty in Afghanistan

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Abstract: How are telecommunications infrastructure, institutions and poverty related in a war-torn economy such as Afghanistan? Afghanistan has been plagued by poor governance, low usage of telecommunications, and extreme poverty levels which can be termed triple-challenges. High levels of political instability affected telecommunications investment and adversely affected the adoption and diffusion of modern technology. This study examines the asymmetric effect of telecommunications and governance (institutions) on poverty reduction over the period 1989–2019 using a nonlinear autoregressive distributed lag (NARDL) model. In the short run, we establish that information and communication technology, private domestic credit, governance, and educational access for males and females are essential tools that can be used for poverty reduction. In the long run, we also establish that Afghanistan can reduce poverty levels through the use of information and communication technology, governance, and educational access for both males and females. The following policy recommendations were suggested: research and development, robust policy formulation on governance and ICT, development of the ICT sector, and improved governance. These are critical in reducing the high poverty levels as well as solving the institutional challenges faced by Afghanistan.

Keywords: conflicts; economic development; governance; poverty; political instability; telecommunications; technology

JEL Classification: E00; E02; E60; I30; I32

1. Introduction

The study examines the asymmetric effect of telecommunications and governance (institutions) on poverty reduction in Afghanistan, which is an Asian landlocked economy. It has a population of over 38 million people, out of which the head-count poverty ratio was 54.5% in 2016 (World Bank, 2021; World Bank, 2024), an indication that more than half of the population is living below the poverty datum line. Political instability and war, which spanned 1978–1992 and 2001–2021, led to high levels of poverty and poor governance issues in Afghanistan (World Bank, 2016; Witte, 2024). The focus on Afghanistan emanates from the observation that it is the country whose economy mostly suffers from a trilogy of challenges, namely poor governance, high poverty levels, and poor and inadequate infrastructure. Thus, there is a need to examine how the aspects in this trilogy are related.

Poverty is multidimensional, encompassing key aspects such as access to education, health, safe water, and sanitation (Walker, 2015). The distribution of poverty is skewed and asymmetric in Afghanistan, since it is more pronounced among rural dwellers, who constitute more than 78% of the population (Noorzoy, 2017). The

major problems facing Afghanistan are high poverty levels, an underdeveloped telecommunications sector, and poor governance. Governance is the administration of political and administrative authority at all levels to manage the nation's affairs, and it includes the processes, techniques, and structures that allow citizens and groups to express their interests, exercise their legal rights, meet their obligations, and mediate their disagreements (United Nations, 2012; Gasik, 2022).

Despite its natural resource endowments, in terms of the human development index (HDI), Afghanistan was ranked 119th out of 195 countries, with a score of 0.51 (United Nations Development Programme, 2021). Such a low HDI score depicts high levels of poverty. This oil-rich nation has been battling with poor governance, limited access to credit for businesses, and political instability for the past two decades (Moret, 2023; Thier and Worden, 2017). In the year 2016, more than 1.2 million Afghan people were internally displaced by the on-going civil war and were exposed to dire poverty (Noorzoy, 2017). Due to the war, hospitals, schools, and other infrastructure that is needed for human survival were destroyed and people became exposed to poverty. Thus, access to public and merit goods in this nation remains limited to the general populace (United Nations, 2021).

Poor governance in this economy has worsened the living conditions of the Afghan people (Decro et al., 2014). The country also recorded a huge loss in foreign direct investment (FDI), such that in 2018 the decline was approximately US\$81 million (World Bank, 2021). This decline implies that the country has limited capacity to develop the ICT sector and other key sectors of the economy. There, the objective of this study is to examine the asymmetric effect of telecommunications and governance (institutions) on poverty reduction in Afghanistan. The study also provides an overview of poverty, governance, and telecommunications trends.

Afghanistan has low levels of development in the information and communication technology sector, which may be largely attributed to the incessant political unrest in the economy since 2003. In 2021, Afghanistan had a mobile phone subscription rate of 59.35% and internet usage (fixed broadband access) of 7% (World Bank, 2021a). Internet access and phone access are crucial for supporting e-commerce activities which increases the gross domestic product (GDP) of an economy. These statistics show that the Afghanistan nation has low rates of telecommunication access and usage and cannot enjoy the associated benefits of a well-developed ICT sector.

Other Asian economies, such as China and Malaysia, are flourishing due to a well-developed ICT sector and have low poverty levels (An et al., 2024; Augustine and Ozor, 2020). In Asia, the average internet penetration rate is 67.4%, while in Afghanistan that is on the same Asian continent, has a meagre 18.4% (Kameke, 2023; Kemp, 2023). Globally, other economies in Europe, like Norway, recorded internet access of 99% in 2022, and they benefit in terms of using the internet to support economic activities as well as supporting welfare programs using proceeds from their high gross domestic levels (Eurostat, 2023; Goncharenko and Shynkarenko, 2022).

Political chaos in Afghanistan has led to the destruction of educational and telecommunications infrastructure; hence, limited educational gains and telecommunications benefits can materialize for this nation. This is evidenced by the fact that more than 300 schools were destroyed in 2016 (Reliefweb, 2021). In 2016 a total of 220 telecommunications towers, valued at US\$50 million, were destroyed

(South Asia Terrorism Portal, 2021). This limits the country's ability to enjoy ICT-related benefits due to such destruction. The central aim of this study is to examine how telecommunications infrastructure and institutions can be used as tools for poverty alleviation in Afghanistan.

Floreani et al. (2016) emphasize that poverty tends to be lower in conflict-stricken areas of Afghanistan due to the influx of foreign aid disbursements. Several studies on the relationship between poverty and conflict in the country have found that conflict has fueled the poverty levels in Afghanistan. For example, research by the Overseas Development Institute (2003) on the role of aid, livelihoods, and conflict on profit and poverty in Afghanistan showed the effects of chronic political instability on livelihoods. Another more recent study revealed that political developments in the second half of 2021 had caused poverty in Afghanistan to rise to historically unprecedented levels (Biruni Institute, 2022). Similarly, evidence has shown that access to education in Afghanistan has been reduced due to an increase in armed conflicts (Utsumi, 2021) and a lack of access to education and other necessities in perpetuity in the vicious cycle of poverty among Afghans, especially underprivileged and vulnerable groups like women (Mihaela et al., 2015; Roy, 2018).

A review of the extant literature indicates the absence of consensus on the best way to successfully eradicate poverty in Afghanistan (Joya et al., 2022; Tamim, 2015; United Nations International Children's Empowerment Fund, 2022). Tamim (2015) discovered that social capital is an essential ingredient for poverty reduction in Afghanistan. However, it is unknown whether social capital is the only long-term solution for poverty alleviation. Despite Afghanistan's concerted efforts to empower its people living in rural areas through the National Solidarity Programme, a larger proportion of its citizens are still living in abject poverty of less than US\$1.25 a day (Beath et al., 2013).

On the other hand, the Ministry of Economy of the Islamic Republic of Afghanistan advocates the strengthening of agriculture and investment in human development as solutions to the eradication of poverty among citizens (Barakat, 2006). This interpretation contrasts the view of the United Nations International Children's Empowerment Fund (UNICEF), which recommends multi-sectorial interventions in health, education, and food security as an alternative to eliminating poverty in Afghanistan (UNICEF, 2023). A different view is given by Joya et al. (2022), who identified different reforms as key strategies for poverty alleviation in Afghanistan. Some of these reforms were: agriculturally led growth, social security policies, and investment in human capital, as well as inclusive reforms. What remains as a missing link in all the extant studies is how poverty and institutional challenges can be solved using ICT as a policy tool in Afghanistan. This makes it evident that no clear solution has been presented so far to address weak institutions and poverty levels in Afghanistan and their interlinkages. To provide this missing link, this study seeks to examine how telecommunications operations and institutions (governance) may be used for poverty alleviation in Afghanistan.

This paper is structured as follows: Section 2 discusses the literature review. Section 3 presents the research methodology. Results are presented in Section 4. Policy recommendations and conclusions are presented in Section 5.

2. Related literature

This section covers the theories and empirical evidence underpinning this study. Under the theoretical section, Diffusion of Innovation Theory and Structural-Functional Theory will be discussed. Empirically, the focus is on the analysis of scholarly work on three subsections, namely the telecommunications-poverty nexus, the telecommunications-institution nexus, and the institution-poverty nexus.

2.1. Theoretical framework

Poverty-related theories are grouped into three strands, namely behavioral, structural, and political (Brady, 2019). Poor policies, designed and implemented by inadequate governments, can result in high poverty levels (Lange, 2021). This is so because some policies will be aimed at averting a political crisis, but at the expense of the welfare of the general populace. The main theories used in this study are structural-functional theory and the diffusion of innovation theory.

2.2. Structural-functional theory

Firstly, the structural-functional theory developed by Herbet Spencer (1820–1903) views society as a system of interconnected parts designed to meet the biological and social needs of its members (Fisher, 2010). Spencer referred to the following social institutions or patterns of ideas and behaviors geared at providing basic needs: government, education, community, healthcare, religion, and the economy (Diago, 2019).

This theory is of value to this research as the country in question has been struggling to address the poverty levels that manifest in the form of poor-quality healthcare and educational access, to mention but a few (Saleem et al., 2021). Poor governance can cause conflicts, which in turn may result in the destruction of diverse kinds of infrastructure, and this ultimately leaves people exposed to poverty (De Matteis, 2013). Thus, institutions have a direct impact on telecommunications and poverty. This is so because the destruction of schools and hospitals, to mention but a few, exposes people to poverty as they will have limited or no access to education or health (Matthews et al., 2014).

2.3. Diffusion of innovation theory

The diffusion of innovation theory examines how members of society adopt new innovative ideas and make decisions about them (Al-Razgan et al., 2021). The diffusion process involves both mainstream media and personal as well as social communication channels. Human capital is a big part of the theory and is facilitated through educational services offered by diverse educational institutions, for example, schools, colleges, and universities (Nordhoff et al., 2021). In addition, human capital is a necessary ingredient to help foster innovation in a community (Oyelana et al., 2021). Thus, it can be deduced that the higher the access people have to education, the higher the levels of human capital in a community, *ceteris paribus*.

According to the theory, in order to achieve development and sustainability, innovations should be commonly embraced (Değerli et al., 2015). Due to the war, little can be harnessed in terms of modern innovation for use in the different sectors of the

economy. As such, the country cannot enjoy the benefits that come from innovation or technological development because it has extremely low rates of diffusion.

In Afghanistan, as discussed in previous segments, educational access to the majority has been limited due to political instability, war, anti-educational policies, and other factors. Poor governance leads to conflicts and the destruction of infrastructure, which ultimately exposes people to poverty as they will have limited access to education, health, and other merit goods that improve living standards. This shows the interconnectedness between poverty and infrastructure. Thus, from this perspective, an indirect linkage exists between telecommunications, institutions, and poverty.

2.4. Empirical literature review

This section presents a discussion of the telecommunications-poverty nexus, telecommunications-institution nexus and institution-poverty nexus.

2.4.1. Telecommunications-poverty nexus

Technological illiteracy adversely affects people's ability to use technology and enjoy different benefits, such as e-commerce activities and the sale of technological products and services. Marett et al. (2015) support the above assertion in their research, which focused on the use of mobile phones in Afghanistan. Research findings indicated that people in Afghanistan have access to mobile phones, but they remain exposed to challenges such as loss of privacy and confidentiality and limited technological know-how (Marett et al., 2015). This indicates that the benefits that come from technological access are limited as well, for example, to e-commerce and online business activities. Thus, some of the Afghan people remain exposed to poverty due to the aforementioned challenges.

Akhgar and Burinskienė (2023) established that internet access and access to mobile phones in Afghanistan are important tools that positively impact economic growth. High economic growth can be achieved through the expansion of business, which also creates job opportunities. These job opportunities help reduce poverty because people are able to earn a living from those incomes. However, the success of the telecommunications sector to positively affect economic growth is dependent on a good investment climate and good infrastructure, among other things.

2.4.2. Telecommunications-institution nexus

Afghanistan's telecommunications sector is greatly affected due to war and weak institutions (governance) in which ICT infrastructure was destroyed. The effect greatly emanates from the weak institutions in the economy. This was brought about by political turmoil, corruption, and the poor existing governance systems leading to the destruction of telecommunications infrastructure (Rahimi, 2015; Salt, 2018). For example, the Afghanistan Telecom Regulatory Authority (ATRA) revealed in 2021 that the Taliban demolished 28 telecommunications towers around the country in the months preceding their takeover of the government (Castro, 2024). This could have affected those who use telecommunications in the different industries, and this could also adversely affect economic activities and potentially lead to a loss of income. Such a loss of income exposes people to poverty.

A lack of sound and reliable telecommunications services affects not only the service providers, but even the general populace and different stakeholders, such as businesses and other end users. This is brought about by poor connectivity affecting business, hurting some entrepreneurs who may not have any substitutes to use. It is important to note that the service sector of any economy requires stable telecommunications services. Lack of such services adversely affects other sectors, such as the manufacturing, mining, and transport sectors, because these sectors are interconnected. For example, the banking sector is a service provider, but if they do not have a stable internet connection and payments are not cleared, products may take a long time to be cleared by the manufacturing sector. Thus, a well-developed telecommunications sector is key to ensuring an effective supply chain (Ning and Yao, 2023).

In addition, Najafizada and Cohen (2017) examined the use of social entrepreneurship in poverty reduction in Afghanistan. Findings from the study indicated that carpet weaving, which is regarded to be a major economic activity in the Bamyan province in Afghanistan, has helped to reduce poverty levels in the community (Najafizada and Cohen, 2017). However, the key stumbling block faced by these social entrepreneurs is that carpet production in a war-torn Afghanistan is still done manually by using some of the primitive methods (Najafizada and Cohen, 2017). This can all be attributed to a lack of modern technology.

It can be argued that, with sophisticated technology, such social entrepreneurs can produce more carpets and employ more people, thereby significantly decreasing the poverty levels in Afghanistan. Thus, solving political turmoil in Afghanistan as well as harnessing the required modern technology for carpet production can go a long way in rescuing millions of people trapped in the vicious cycle of poverty. This is essential, since past research has shown that political instability reduces economic growth and promotes an increase in poverty levels, for example in Pakistan, which is neighboring Afghanistan (Tabassam et al., 2016).

Finally, Noori (2021) examined the effects of the COVID-19 pandemic on educational access for students in higher educational learning institutions. From the study, it was discovered that poor internet access and a weak online platform affected the learning process for diverse students, especially those in rural areas. This shows that the state of the telecommunications infrastructure in Afghanistan needs to be improved to improve educational access and ultimately help in poverty reduction.

The hypothesis is formulated as follows:

H_0 = There is no asymmetrical relationship between telecommunications infrastructure, institutions and poverty in Afghanistan.

H_1 = There is an asymmetrical relationship between telecommunications infrastructure, institutions and poverty in Afghanistan.

2.4.3. Institution-poverty nexus

Utsumi (2021) carried out research of the effects of armed conflicts on access to education in Afghanistan. Logit regressions were used in the study. Research findings indicated that access to education was reduced due to an increase in armed conflicts (Utsumi, 2021). The World Bank (2024) concurs with the above findings and points out that 75.6% of Afghans are illiterate.

Thus, poor governance and limited access to education are the key drivers of poverty in this Asian economy (Ahmadzai and McKinna, 2018). This is justified by the fact that poverty can be viewed through the lens of access to education, health, and other indicators (United Nations Development Programme, 2024), showing that conflicts exacerbate people's suffering from poverty. This position is further justified by the fact that poverty is a multidimensional aspect and also incorporates access to education and health, among others (Ezadi et al., 2022).

The Swedish International Development Cooperation Agency (SIDA) (2017) indicated that the Afghan government struggles to address air pollution and provide basic service delivery to its people. Unclean air exposes people to health hazards such as tuberculosis, and this can be viewed as exposure to poverty when we look at it from a health perspective (United Nations Development Programme, 2024).

The conclusion that can be drawn from the literature is that poverty reduction can be achieved using different tools. It was established that ICT is useful for e-commerce activities, and the growth of the ICT sector enables job creation (Marett et al., 2015). Good governance is also very crucial in building investor confidence, and this promotes the growth of the business sector and helps to foster employment creation (Ukwandu, 2019). This also works well when there is provision for credit facilities from financial institutions, which will help in business expansion and employment creation (Moret, 2023). From the discussion, it was indicated that access to education is also very crucial for enhancing one's ability to acquire a job in the labour market, and this ultimately helps in poverty reduction (Utsumi, 2021).

3. Methodology

The methodology of the study is drawn from the work of Behera and Sahoo (2022), who carried out a similar study, but with a focus on India. Poverty was treated as the dependent variable and measured using the Human Development Index (HDI). The index is effective for measuring poverty because it considers key aspects such as income, education, and healthcare (Kovacevic, 2019). Furthermore, health and education criteria contained in the HDI are also part of the multidimensional poverty index, which is one of the most rigorous proxies for measuring poverty (United Nations Development Programme 2022; Vollmer and Alkire 2022). HDI was also used because it gives robust estimates for poverty measurement (Korankye et al., 2020; Beja, 2021). Finally, the HDI is a useful measure for informing public policy and it is also on this basis that this index was used for poverty measurement (Bagolin and Comim, 2008).

ICT was added as a variable, and it was measured using the ICT composite index. To create this index, the author combined the following three measures: fixed internet usage per 100 individuals, fixed telephone usage per 100 people, and mobile phone usage per 100 people. All these measures are used by the World Bank to measure internet, fixed phone, and mobile phone usage in a country (World Bank, 2024b). A principal component analysis was utilized to combine the three indicators. The justification for employing this technique is that it allows for the formulation of comprehensive policies on the subject matter (Asongu and Le Roux, 2017; David, 2019). Other researchers have employed this strategy, and it is thought to be effective

for inferential validity (Asongu and Nwachukwu, 2016; Tchamyou, 2016). Governance was included as a factor in the study and measured using the Country Policy and Institutional Assessment Score (World Bank, 2024c).

Education is a key issue that creates opportunities for people to get jobs, which then allows them to earn a living and be rescued from poverty (Phan, 2018). Access to education is different for males and females. In this study, school enrollment for males and females at the secondary level was added as a variable, and it was measured using a percentage. Junjuna (2023) posited that global poverty rates can be reduced by 50% if people complete secondary education, which is also an important prerequisite for getting into tertiary education. It is on this basis that school enrollment at the secondary level was added as a variable. However, there is no data on secondary pass rates for Afghanistan for the period 1989–2019, and school enrolment rates at the secondary level were used as a close proxy to measure educational level (Sibanda and Iwu, 2021). Due to data unavailability, the study did not use school enrollment at the tertiary level. Finally, these variables were added because they have an influence on the dependent variable.

Lastly, private domestic credit was included in the research because credit positively influences business expansion, and normally such an expansion is associated with job creation and poverty reduction (Nsiah et al., 2021). Therefore, the availability of credit for business expansion can lead to poverty reduction, though in a non-deterministic way.

3.1. Econometric approach

The non-linear auto-regressive distributed lag (NARDL) model is an enhanced version of the linear ARDL model (Pesaran et al., 2001). The research adopts a NARDL model propounded by Shin and Nimo (2014) to test the effects of telecommunications and institutions on poverty. This method is useful for examining the long-term and short-term asymmetric influence of both positive and negative components. The model can be used when the variables are stationary at the level, I (0), at the first difference, I (1), or a combination of the two, except stationary at the second difference, I (2). Furthermore, the NARDL model supports the ARDL bounds testing method for calculating the asymmetric short-run and long-run coefficients in a cointegration framework. When analyzing co-integration relations in small samples, the NARDL model performs better since it is not data hungry (Romilly et al., 2001). It also produces more efficient and consistent estimators than any other estimation techniques, especially a small sample like ours (Shin and Nimo, 2014). This study used a small sample with data from 1989–2021 which suits the use of NARDL. The econometric model is presented below:

$$\Delta Y_{it} = \alpha_1 + \sum_{i=1}^p \beta_i \Delta Y_{it-i} + \sum_{i=0}^q \delta_i \Delta X_{it-i} + \varphi_1 Y_{it-1} + \varphi_2 X_{it-1} + \varepsilon_{it} \quad (1)$$

where ΔY_{it} represents a vector of $(k \times 1)$ covering poverty measured using the Human Development Index (HDI), Δ captures differences in operator, X_1, y_1 are the independent variables for every $i = 1$ which were information and communication technology (ICT), governance (GOV), private domestic credit (PDC), school enrolment for males (SEM), and school enrolment for females (SEFM), β_i and δ_i

represent the short-run coefficients of the model explaining the short-run relationships between the variables, φ_1 , φ_2 represent the long-run relationship, p and q represent the lags of the dependent variable and the independent variables, respectively, and ε_{it} is the error term.

The next section presents a summary of the variables used in the study. The table shows the variables, indicator, variable description, unit measurement, and the sources of data used.

3.2. Data, variable definition and sources

Table 1 below shows the summary of the variables used, indicators used, unit of measurement and the data source.

Table 1. Summary of variables.

Variable	Indicator	Variable Description	Unit of measurement	Source of Data
HDI	Human Development Index	Proxy for poverty measurement made up of key factors such as health, education and standard of living.	Index	United Nations Development Programme (2022)
ICT	Composite Index of Telecommunications	Principal component value of connected mobile phones, percentage of people with access to internet as well as penetration of fixed lines.	Index	Author Computation based on International Telecommunication Union (2022), World Bank (2022)
GOV	Governance	A composite index based on all six World Governance Indicators.	Index	World Bank (2024)
SEFM	School enrolment Ratio for females	Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown (secondary level)	Percentage (%)	World Bank (2022)
SEM	School enrolment Ratio for males	Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown (secondary level)	Percentage (%)	World Bank (2022)
PDC	Private domestic credit	This incorporates all financial resources provided to the private sector such as loans, purchases of non-equity securities, and trade credits as well as accounts receivable.	(% of GDP)	World Bank (2022)

3.3. Results and discussion

This section seeks to present the results and discussion of the study.

3.3.1. Descriptive trends

The descriptive statistics presented here will be based on the following key variables of the study: poverty, telecommunications, and governance. In this discussion, the first quarter will refer to the period 1989–1996, the second quarter 1997–2004, the third quarter 2005–2012, and the fourth quarter 2013–2019. This was done to simplify the analysis.

3.3.2. Telecommunications

The descriptive statistics presented here will be based on the following key variables of the study: poverty, telecommunications, and governance. In this discussion, the first quarter will refer to the period 1989–1996, the second quarter 1997–2004, the third quarter 2005–2012, and the fourth quarter 2013–2019. This was done to simplify the analysis.

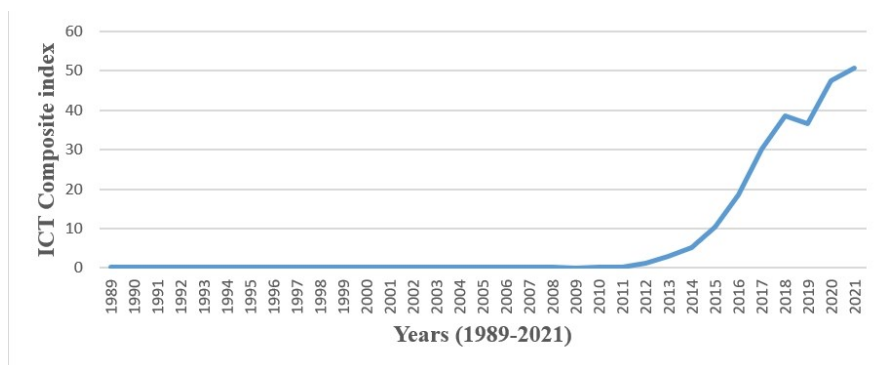


Figure 1. Telecommunications usage trend: 1989–2019.

Source: Researcher’s construct based on world bank data (2023).

Figure 1 shows that in the first and second quarter the ICT index was extremely low; it was below 10. In the last quarter, there was a sharp increase in the ICT index and there were minor fluctuations as well.

The low usage of ICT in this economy can be attributed to the control of the internet and related services by the state, as well as the destroyed ICT infrastructure (Khan et al., 2012). Overall, Afghanistan has low usage of fixed phones, the internet and mobile phones for the period 1989–2021.

3.3.3. Poverty

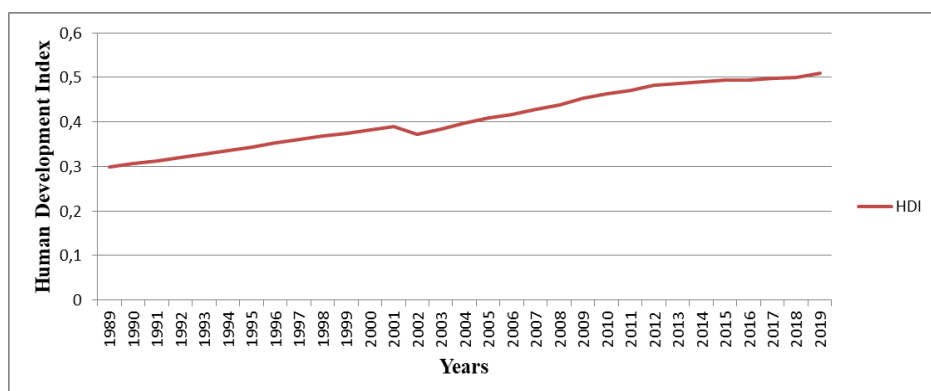


Figure 2. Poverty trend: 1989–2019.

Source: Researcher’s Construct based on World Bank data (2023).

Figure 2 shows the poverty trend. In the first quarter Afghanistan recorded a low increase in HDI, and at the end of the first quarter the index was below 0.4. This implies that there was poor quality of life and poor health standards, low educational rates, and low income per capita, as well as low standards of living. This could have been attributed to perennial conflicts and the wars in the economy (Haidari et al., 2023). In the second quarter, the nation recorded a slight increase in HDI, and at the end of

2004 the HDI was at 0.4. In the third and fourth quarters, Afghanistan recorded an increase in HDI up to 0.5 overall. There have been some improvements in the HDI of Afghanistan, but the HDI of 0.5 shows that the nation is still plagued by high poverty levels.

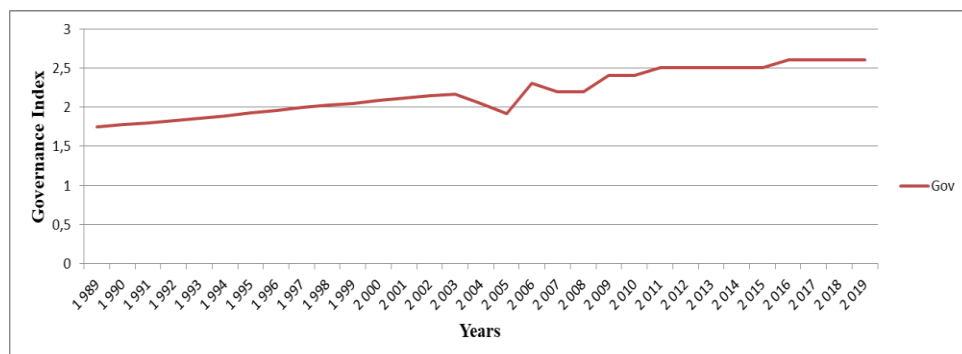


Figure 3. Governance trend: 1989–2019.

Source: Researcher’s construct based on world bank data (2023).

Figure 3 shows that Afghanistan recorded a steady increase in terms of governance and an index of 2. In the second quarter, there was a minor increase in the governance index, and there were minor fluctuations as well. Key to note is that between 2002 and 2009 there were fluctuations in governance levels, and this could have been attributed by the war between the USA and Afghanistan (Salt, 2018). In the third quarter Afghanistan managed to recover from the fluctuations and recorded a governance index of 2.5. In the last quarter, there was an insignificant increase in the governance indicator of Afghanistan, the governance index then being at 2.6. Overall, the economy has low levels of good governance. This implies that Afghanistan has poor performance in the following key areas: voice and accountability, political stability, absence of violence or terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption.

In short, the Afghan people, in terms of voice and accountability, have a limited role to play in the selection of their government and limited freedom of expression, media, and association (Human Rights Watch, 2021). Apart from that, they are exposed to high levels of political instability and violence. This is supported by the prior discussion of this article in the introduction. In addition, the low governance index in Afghanistan depicts a poor quality of public and civil service, poor quality policies, and limited commitment by the government to policies formed. Furthermore, it can also be concluded that in Afghanistan there is poor regulatory quality, which manifests in the form of the inability of the government to promote private sector development. Lastly, based on the governance trend depicted in **Figure 3**, it can be concluded that there is poor rule of law and that the corruption levels need to be reduced.

3.4. Descriptive statistics

This section presents the descriptive results.

Table 2 shows that the mean, median, and maximum for Afghanistan were 0.40, 0.39, and 0.51, respectively. A low HDI value implies a high poverty rate, and this

shows that the country has high poverty levels for the period in question. In terms of ICT, the mean, median, and maximum were 7.54%, 2.55%, and 66.28%, respectively. This signifies low rates of ICT development. In terms of Gov, the mean, median, and maximum were 2.18%, 2.14%, and 2.60%, respectively. These statistics show that there is a low level of governance. In terms of PDC, the mean, median, and maximum were 9.31%, 10.15%, and 15.76%, respectively. These statistics show low levels of private domestic credit. In terms of SEM, the mean, median, and maximum were 42.77%, 33.84%, and 72.51%, respectively. Finally, in terms of SEFM, the mean, median, and maximum were 19.58%, 10.52%, and 40.32%, respectively. Based on these SEM and SEFM statistics, it shows that Afghanistan has relatively low rates of male enrolment in the educational sector.

Table 2. Descriptive results.

	HDI	ICT	GOV	PDC	SEM	SEFM
Mean	0.40	7.54	2.18	9.31	42.77	19.58
Median	0.39	2.55	2.14	10.15	33.84	10.52
Maximum	0.51	66.28	2.60	15.76	72.51	40.32

3.4.1. Diagnostic checks

Table 3. Unit root test.

Variable	ADF test		PP test		ZA test with structural break point		
	Level	1st Diff	Level	1st Diff	Level	1st Diff	Break Year
HDI		0.00 (-4.53)		0.00 (-4.54)		0.00	2009
ICT		0.00 (-4.46)		0.00 (-4.46)		0.00	2011
PDC		0.00 (-5.30)		0.00 (11.20)		0.00	2008
GOV	0.00 (-6.51)		0.00(-6.51)		0.00(-7.80)		2009
SEMS		0.00 (-6.65)		0.00 (-6.65)		0.00	2008
SEF		0.00 (-2.65)		0.00 (-2.68)		0.00	2008

() represents *t*-value.

Table 3 shows that the Augmented Dick-Fuller test, the Phillips-Perroni test, and the Zivot-Andrews test were used to test for unit roots in the research. The results indicated that the HDI, ICT, PDC, SEM, and SEFM were stationary after the first difference. GOV was stationary at level. The Zivot-Andrews tests were used for robustness and to avoid biasedness emanating from ADF and PP due to their failure to identify and account for structural breaks. Similar results were obtained, and the associated break years were obtained for each variable as shown in the table.

Table 4. VAR lag order selection criteria.

Lag	LogL	LR	FPE	AIC	SIC	HQIC
0	-201, 21	NA	0.004	14.35	14.68	14.46
1	-38.67	235.40	1.79	6.52	9.16	7.35
2	56.86*	92.25*	1.49*	3.31*	8.27*	4.86*

Note: * indicates lag order selected by the criterion (each test at 5% level).

Table 4 shows the results of the lag length test and 2 was selected as the desirable lag in this research because it had a lower value of 3.31 based on the Akaike information criterion.

Table 5. Bounds test for cointegration in the linear and nonlinear specifications.

Dependent: HDI	F-Statistic	lower bound	upper bound	Outcome
NARDL Model (1,1,1,1,1, 1,0,0,1,1,1,1,1)	24.06	2.41	3.61	Cointegrated

To test for co-integration, the bounds test was used, and the F-statistic of 24.06 was greater than the upper bound I (1) value of 3.61 as reported in **Table 5**. It was therefore concluded that there was a long-term asymmetric relationship between the variables used in the study, which are the Human Development Index, information and communication technology, private domestic credit, governance, and school enrolment for males and females. Since there was cointegration among the variables, the error correction model was estimated to get the short-run dynamics as shown below.

3.4.2. Error correction model

Table 6. Error correction model results.

Variable	Coefficient	P-value
ICT	0.07	0.00***
GOV	0.10	0.00***
PDC	0.01	0.00***
SEM	9.75	0.00***
SEFM	0.06	0.00***
ECM	1.00	0.00***

Note: ***, ** and * denotes 1%, 5% and 10% respectively.

Table 6 shows that the ECM was positive and statistically significant at the 1% level. All the variables were statistically significant at the 1% level. If ICT increases by 1%, HDI will increase by 7% in the short run. An increase in HDI levels implies a decrease in poverty levels. This signifies that ICT is useful for poverty reduction in Afghanistan. If GOV increases by 1%, HDI will increase by 10% in the short run. This implies that a good governance system helps to reduce poverty levels. In terms of PDC, a 1% increase in PDC leads to a 1% increase in HDI levels in the short run. This also shows that PDC is useful for poverty reduction. In terms of SEM, a 1% increase leads to a 9.75% increase in HDI levels in the short run. This result implies that access to education by men helps reduce poverty levels. On the other hand, a 1% increase in access to education by women leads to a 6% increase in HDI levels in the short run. Overall, it can be concluded that education for both men and women is useful for poverty reduction in Afghanistan. Finally, the ECM was positive and statistically significant at the 1% level.

3.4.3. Linear and monotonic correlations

Pearson and spearman rank correlations

Pearson correlation measures the level of strength of variables in a study (Schober et al., 2018). On the other hand, Spearman’s rank correlation assesses the strength and direction of a link between two ranked factors (Al Hameed, 2022). In this study, the Pearson and Spearman correlations were calculated for the salient variables, which were poverty, governance, and information and communication technology and their respective results are reported in **Tables 7** and **8**.

Table 7. Pearson rank correlations.

VARIABLES	GOV	HDI	ICT
GOV	1.000		
HDI	0.97 (0.00) ***	1.000	
ICT	0.97 (0.00) ***	0.99 (0.00) ***	1.000

Tables 7 and **8** show that the linear (monotonic) relationship between HDI, which was used as a proxy for poverty measurement, and GOV was positive and statistically significant because the value of 0.97 (0.96) is close to 1. This suggests that, in Afghanistan, ICT and GOV are strongly correlated. Evidence of a significant and strong linear (monotonic) association of a magnitude of 99% (98%) between ICT HDI, was also observed.

Table 8. Spearman rank correlations.

VARIABLES	GOV	HDI	ICT
GOV	1.000		
HDI	0.96 (0.00) ***	1.000	
ICT	0.96 (0.00) **	0.98 (0.00) ***	1.000

3.5. Long-run asymmetric dynamics (NARDL)

This section presents the long-run asymmetric dynamics of the NARDL.

Table 9 reports results which show that ICT was significant at the 1% level. In terms of the coefficient, a 1 unit increase in ICT will lead to a 14% increase in the human development index. A decrease in HDI levels implies an increase in poverty levels. This shows the response of HDI to positive changes in ICT. On the other hand, a unit decrease in ICT leads to a 19% decrease in HDI. This shows that ICT is useful for promoting poverty reduction in Afghanistan. These results are on par with the views of Dzator et al. (2023). The partial sum of positive changes of 14% is smaller than the partial sum of negative changes of 19% for poverty, indicating a significant long-run asymmetry between poverty and ICT. This shows that, in Afghanistan over the period 1989–2019, HDI is more sensitive to negative ICT shocks than it is to positive shocks. It is essential for Afghanistan to harness ICT usage for use in different sectors of the economy for job creation and supporting the provision of ICT-related services. This will ultimately help in poverty reduction. This is so because the expansion of the ICT sector creates jobs, and the income earned from those jobs can help with the purchasing of different goods and services for survival (Ayo, 2022; Ngubane et al., 2023).

Table 9. Long-run asymmetric results of NARDL.

Variable	Model 2
Panel A: Long-run results of NARDL	
ICT pos	(0.14) 0.01***
ICT neg	(0.19) 0.01***
GOV pos	(0.09) 0.00***
GOV neg	(-0.08) 0.07*
PDC pos	(0.01) 0.18
PDC neg	(0.03) 0.00***
SEM pos	(0.06) 0.08*
SEM neg	(0.01) 0.00***
SEFM pos	(0.03) 0.01***
SEFM neg	(0.04) 0.00***
Diagnostic tests (<i>p</i> -values)	
Heteroscedasticity (Breusch-Pagan-Godfrey test)	0.43
Serial correlation (Breusch – Godfrey test)	0.49
Model specification (Ramsey RESET test)	0.99
Normality (Jarque-Bera test)	0.60

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Co-efficient are in parenthesis
Model 2 was used based on the lag-length criteria.

To add to that, in terms of GOV, a unit increase in GOV will lead to a 9% increase in HDI levels. This implies that good governance is useful for poverty reduction. On the other hand, a unit decrease in GOV leads to a decrease in HDI by 8%. The partial sum of positive changes of 9% is greater than the partial sum of negative changes of 8% to HDI levels, indicating a significant long-run asymmetry between poverty and governance. This shows that poverty is more sensitive to positive governance shocks than it is to negative shocks. Based on these research findings, it can be concluded that good governance can be attained through well-managed economic systems, robust structural policies, and efficient public sector management and institutions, as well as good policies for social inclusion and equality (Coccia, 2021; Fortemps, 2022). These are the key pillars of good governance, and Afghanistan needs to improve in all these areas to ensure that poverty is reduced. This can be achieved by repealing some of the policies that limit access to education for women, among others. This is crucial because lack of education implies exposure to poverty, as discussed prior.

About SEM: a unit increase in SEM will result in a 6% increase in HDI levels. This implies that, as more males acquire education, poverty levels drop. This is empirically true and can be supported by the fact that Afghanistan is a patriarchal society that has a labour force that is male dominated (Das and Rai, 2022). Thus, as more males get education, it increases their opportunities to be engaged in economic activities that help them earn an income, hence reducing poverty levels.

On the other hand, in terms of the negative response of HDI to changes in SEM, a unit decrease in SEM leads to a 1% decrease in HDI levels. The partial sum of positive changes of 6% is greater than the partial sum of negative changes of 1% for

poverty, indicating a significant long-run asymmetry between HDI and SEM. This shows that poverty is more sensitive to changes in SEM levels in Afghanistan.

For SEFM, a unit increase in SEF leads to a 3% increase in HDI levels. Thus, as women acquire more education, the degree of poverty tends to decrease. This can be supported by the fact that women normally look after families and, as they earn an income, the lives of the people that depend on them may significantly improve, thus lowering poverty levels (Sarwar and Chaudhry, 2021). Conversely, a unit decrease in SEFM leads to a 4% decrease in HDI levels. The partial sum of positive changes of 3% is smaller than the partial sum of negative changes of 4% to poverty levels, indicating a significant long-run asymmetry between HDI and SEFM. This shows that HDI is more sensitive to changes in SEFM levels in Afghanistan.

3.5.1. Post estimation tests

Tests for serial correlation and heteroskedasticity were carried out as post-estimation tests. The Breusch-Pagan Godfrey tests were used to test for heteroskedasticity.

Table 10. Post estimation test results.

Type of test	F-statistics	P-value
Breusch Godfrey Serial Correlation LM test	1.13	0.48
Breusch-Pagan Godfrey test	0.38	0.96
Jarque-Bera test	0.53	0.76

The Breusch-Godfrey serial correlation LM test was used to test for serial correlation. **Table 10** shows that the *p*-value of 0.48 was greater than the 5% significance level; hence, it was concluded that there was no serial correlation. The Breusch-Pagan Godfrey Test was used to test for heteroskedasticity, and the results show that the *p*-value of 0.96 was greater than 0.05, indicating absence of heteroskedasticity. The Jarque-Bera test, resulting with a *p*-value of 0.76 exceeding 0.05, confirmed that the residuals are normally distributed.

3.5.2. Stability tests

To test for parameter stability, the cumulative sum (CUSUM) of recursive residuals and the CUSUM of squares (CUSUMSQ) tests were used (Pesaran and Pesaran, 1997) of which the results are reported in **Figures 4** and **5**.

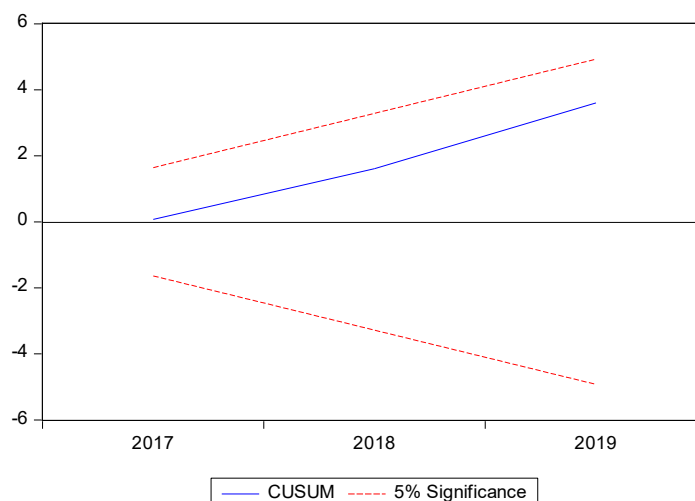


Figure 4. CUSUM test.

Figure 4 shows that the model lies within the 5% boundary; hence it can be concluded that the model was s.

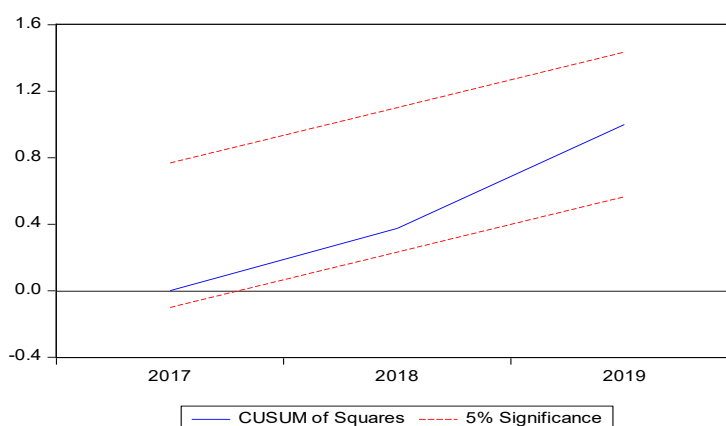


Figure 5. CUSUM squares.

Figure 5 shows that the model lies within the 5% boundary hence it can be concluded that the model was stable.

4. Conclusion and policy recommendations

The research examined the asymmetric effect of telecommunications and governance (institutions) on poverty reduction over the period 1989–2019 using a nonlinear autoregressive distributed lag (NARDL) model. It can be concluded that, in the short term, information and communication technology, private domestic credit, governance, and educational access for both men and women are critical tools for poverty reduction. In the long run, it was shown that Afghanistan can alleviate high levels of poverty using information and communication technologies, good governance, and equal access to education for both men and women. The following policy recommendations were suggested: research and development, robust policy formulation on governance and ICT, development of the ICT sector, and improving governance.

It is also of great importance for Afghanistan authorities to address poor governance and other challenges that were discussed in this study. This is crucial since the economy will then be able to develop economically and it also improves the chances of the economy attaining some of the selected SDG goals. The following policy recommendations are made.

4.1. Improving governance

Afghanistan needs to ensure that they improve their governance levels, and the main focus should be on addressing the most crucial shortcomings cited. It is also essential for Afghanistan to ensure that the good governance policies they crafted are well implemented. This will help reduce poverty levels.

4.2. Development of the ICT sector

The ICT sector in Afghanistan must be developed. Some of the measures that can be taken may be to liberalize the telecommunications sector as well as ensure that there is an enabling ICT infrastructure. All ICT development initiatives should be from the grassroots level to ensure that there is high development and that the country can benefit from the use of ICT in poverty reduction.

4.3. Robust policy formulation on governance and ICT

We recommend the need to develop robust policies that are ICT- and governance-related. These policies should be tailor-made to address the exact governance and ICT challenges faced by the country. The key to note is that these policies must be backed by enough financial and non-financial resources to increase their chances of success. This will ultimately help in poverty reduction in the medium to long term, provided the proceeds generated from the use of policies in different sectors are channeled towards improving the lifestyles of the poor.

4.4. Research and development

Finally, there is a need for more research and development to be done on governance, ICT, and poverty reduction. This is crucial since there are different actors that continue to affect these issues. As such, research and development will help to provide a basis for high-quality decision-making on how to tackle poor governance, poor ICT status, and high poverty levels. This can be done by strengthening educational institutions and other research centres.

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