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Information and Communication Technologies (ICTs) as catalyst for the achievement of Sustainable Development Goals (SGDs) at the local level in Africa

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Information and Communication Technologies (ICTs) as catalyst for the achievement of Sustainable Development Goals (SGDs) at the local level in Africa

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Abstract

This study evaluates if information and communication technologies (ICTs) can play a role of catalyst for the achievement of most of the United Nations' Sustainable Development Goals (SDGs) at local level in African countries. We use the Afrobarometer Round 7 Surveys, and base our empirical methodology on 2SLS-IV regressions to take into account the concern of reverse causality. The findings reveal that ICTs have a positive and significant effect on the achievement of SDGs, notably, in eight out of thirteen goals (Goal 1 "No poverty", Goal 2 "Zero Hunger", Goal 6 "Clean water and sanitation", Goal 8 "Decent work and economic growth", Goal 11 "Sustainable cities and communities", Goal 5 "Gender equality", Goal 7 "Affordable and clean energy", Goal 9 "Industry, innovation and infrastructure"). The results suggest that ICTs can help to accelerate progress towards SDGs in Africa.

Keywords: information technology; inclusive development; sustainable development
JEL Classification: D10; D14; D31; D60; O30

1. Introduction

A large body of the literature has linked the achievement of sustainable development goals (SDGs) and information and communication technologies (ICTs). ICTs are considered as essential for the achievement of SDGs. For example, Nchoufoung and Asongu (2021) found that ICTs have a positive and significant effect on sustainable development. In effect ICT could accelerate the process of this transformation by giving many opportunities. Prioritizing ICT investment in order to boost sustainable development is a new approach as promoted and articulated by both scholars and stakeholders. According to the Mckinsey Global Institute (2013), mobile internet is one of the twelve disruptive technologies with a very high potential economic impact. For Nchoufoung and Asongu (2021), the existing literature can be split up into three principal strands, namely environment, social and economic views. On the one hand, some authors argue that ICTs negatively impact the environment by increasing carbon dioxide (CO_2) emissions (Avom *et al*., 2020; Chen, 2021; Liu *et al*., 2021; Su *et al*., 2021). For example, Li *et al*. (2022) investigate the effect of green investment, economic growth, technological innovation, non-renewable energy use and globalization on CO_2 emission in the MINT (Mexico, Indonesia, Nigeria and Turkey) countries. The authors find that non-renewable energy and technological innovation significantly increase environmental degradation while the moderation effect of technological innovation and globalisation significantly reduces the emission level.

On the other hand, a wave of authors such as Ahmed and Le (2021), Wang and Xu (2021), Ndri *et al*. (2021), Chien *et al*. (2021), Chen and Lee (2020), Kumail *et al*. (2020), Ke *et al*. (2020), Anwar *et al*. (2021) and Yang and Li (2017), *inter alia*, reveal that ICTs increase environmental performance by reducing CO_2 emission. We can also note that some authors have established a non-linear relationship based on interactive regressions. For example, Ganda (2019) evaluates the link between technological innovation and environmental degradation. The results of the author suggest that technological innovation significantly enhances environmental performance through investment in the research and development (R&D) sector. Accordingly, Chien *et al*. (2021) found that the effect is lowest in magnitude at lower quantiles and highest at higher quantiles of environment pollution.

Regarding the impact of ICTs on the socio-economic dimension, there is an abundant literature. In recent years, a growing number of works have acknowledged that ICTs increase inclusive human development (Asongu & Nwachukwu, 2016; Asongu & Le Roux, 2017;

Asongu *et al*., 2017; Asongu & Odhiambo, 2019a), and improve quality education and favourable income redistribution (Asongu & Odhiambo, 2019b; Tchamyou *et al*., 2019; Adams & Akobeng, 2021) while other authors detect non-linearities and indirect effects (Richmond & Triplett, 2018; Njangang *et al*., 2021; Asongu *et al*., 2019). Similarly, Mimbi and Bankole (2015), Majeed and Khan (2019), Dutta *et al*. (2019), Koutou *et al*. (2020), Lee and Lio (2016) establish a positive and significant effect of ICTs on health. The latter authors found that the diffusion of the internet, mobile phones and fixed phones is combined with both higher life expectancy and a reduction of infant mortality.

Another strand of the literature has pointed out that ICTs contribute to economic growth, reduce poverty, boost financial development and improve quality of life (Nasab & Aghaei, 2009; Chang *et al*., 2021; Alshubiri *et al*., 2019; Asongu *et al*., 2019; Albiman & Sulong, 2017; Kumar *et al*., 2015; Ward & Zheng, 2016; Aker & Mbiti, 2010; Kpodar & Adranaivo, 2011; Chavula, 2013; Salahhuddin & Gow, 2016; Ofori & Osei, 2022; Ofori *et al*., 2021; Mushtaq & Bruneau, 2019; Toader *et al*., 2018; Zagorchev et al., 2011; Niebel, 2018; Haftu, 2019 ; Latif *et al*., 2018; Asongu *et al*., 2022). The impact of ICT on economic growth is assessed by Niebel (2018) in 59 developing, emerging and developed countries over the period 1995-2010. The author found a positive impact of ICTs on economic growth for the whole sample of countries. In the same vein, Haftu (2019) examines the impact of telecommunication infrastructure on economic growth and shows that expanding ICT plays an important role in increasing per capita income. More precisely, the results indicate that a 10% increase in mobile phone penetration induces a 1.2% change in gross domestic product (GDP) per capita. According to OECD (2010), ICT can help reduce poverty by creating new sources of income and new jobs, but also by diminishing the cost of poor people to health and education services.

The findings established between ICTs and the achievement of SDGs in the previous literature raise the concern on the need to investigate the relationships at a more disaggregated level. In effect, there has been increasing interest in local level implementation of the United Nations' 2030 Agenda for sustainable development, especially as it pertains to the attendant SDGs (Masuda *et al*., 2021). Moreover, achieving the corresponding global aspirations requires local commitment and the actions of local government (Satterthwaite, 2017). As noted by Allen *et al*. (2018) and Morita *et al*. (2019), domestic governments are actively promoting initiatives to localize their achievements in SDGs. This preference could be

validated by the recognition of the importance of applying the United Nations' 2030 Agenda at a local level (UN General Assembly, 2019). Moreover, the increasing global trend towards local approaches can be justified by the fact that the call for sustainable development is being heeded at the local level (Local, 2030, 2020).

To the best of our knowledge, there is no local level study referring to the effect of ICTs on in the achievement of most of the SDGs in African countries. As covered in the previous paragraphs, there is however a broad existing literature suggesting that ICTs improve quality of life and education, reduce inequality, increase environment performance, boost GDP growth and improve financial development. In the present study, the analysis is tailored such that a local level perspective is incorporated in order to evaluate the role played by ICTs in the achievement of SDGs. Based on a sample of 400 regions in 34 African countries from Round 7 of Afrobarometer survey, we estimated the attendant nexuses between ICTs and most SDGs with emphasis on local realities. For most goals (on 13 out of the 17 existing goals), we calculate an index of ICT. Accordingly, ICT is proxied by an index related to the responses on connectivity (internet and mobile). The contribution of our study to the extant literature discussed in the previous paragraphs is threshold. Firstly, while the existing literature has been oriented towards the effect of ICTs on a limited number of goals, the present study investigates the impact on most SDGs (13/17 goals). More precisely, we define an index for every goal to test the nexus. Secondly, while the previous literature has focused on the nexus based on country level analyses, in the present study, a local level approach for a more disaggregated investigation is engaged. Thirdly, since ICTs and SDGs are mutually reinforcing in a reciprocal pattern, we use an Instrumental Variable (IV) method to solve the endogeneity concern related to simultaneity or reverse causality within the remit of cross section data.

The remainder of the work is structured as follows. Section 2 provides a theoretical framework and a presentation of the data. Section 3 covers the empirical methodology. Section 4 discusses the results while Section 5 concludes.

2. Theoretical framework and presentation of data

This section first presents the methodological framework for the construction of the composite indexes with the main steps required before presenting the data.

In their handbook on constructing a composite indicator, the organisation for economic co-operation and development (OECD) and Joint Research Centre (2008) robustly provided different steps in the development of an index. According to this handbook, the most important steps are: (i) the justification of the theoretical framework, (ii) definition of dimensions and (iii) selection of variables. The theoretical framework represents the starting point of the composite indicator we need (Park & Claveria, 2018).

The SDGs and ICTs indexes presented in this work are constructed from the Round 7 Afrobarometer Survey. The Afrobarometer Survey is a collaboration between the Institute for Justice and Reconciliation in South Africa (IJR), the Institute for Development Studies (IDS) in the University of Nairobi (Kenya), the Centre for Democratic Development (CDD-Ghana), and the Institute for Empirical Research and Political Economy (IREEP) in Benin. The University of Cape Town and the Michigan State University also contribute a technical support to the program. In Round 7, the Afrobarometer developed highlights individuals' experiences in some indicators which we can compare to the conventional SDGs defined by the United Nations. Among these sustainable development components, the Afrobarometer provides data on poverty, hunger, health and well-being, education, energy supply, water and sanitation, inequality, gender equity, employment, sustainable cities, climate action and justice, *inter alia*. Even though Afrobarometer surveys are not intended to replace the official indicators tracking progress toward the SDGs, it can provide a strong alternative to participate to the debate. The choice of Afrobarometer surveys to construct the indexes can be justified by the fact that these data are valuable because of attendant independence, quality, reliability as well as the possibility to track the progress on local level analysis. Indeed, the Afrobarometer offers an independent check contrary to the global statistics provided by governments or other sources.

Of the 17 United Nations' SDGS, 13 indexes are constructed, respectively. The selected variables are fundamental to sustainable development components. In Table 1, we describe the different indicators we use to construct the indexes. For every goal, we find a corresponding indicator that best captures the official United Nations measurement of the progress toward the SDGs. For example, for "Goal 1: No Poverty", we use Afrobarometer indicators such as handling and managing the economy, improving living standard of the poor and the number of times people go without cash money. Regarding "Goal 2: Zero Hunger", *inter alia*, the number of times without food, and ensuring enough to eat are selected. We use

67 indicators that measure different aspects of the SDGs to construct the 13 indexes in every region. For “Goal 12: Responsible consumption and production”, “Goal 14: Life below water”, “Goal 15: Life on land”, “Goal 17: Partnerships for the goals”, indexes are not computed because of lack of relevant indicators.

To construct our different indexes, the individual responses of the survey are identified in order to calculate the proportion of people who are in a favourable situation in every region. As shown in Table 1, this favourable response is defined as the reference. Then, all indicators positively influence the achievement of SDGs. In this study, the term “favourable response” refers to the proportion of people in the region who are considered to be in a privileged position in the SDG agenda regarding the question being answered. For example, with respect to the question “How often gone without food”, a value of 0.7 indicates that 70% of the population in the region has never gone without food against 30%. Thus, the more the proportion is higher, the more people in that region are close to achieving Goal 1 (No poverty).

After the theoretical framework and data selection, we proceed with normalizing and aggregating the indicators. In the literature of index construction, a large number of data normalization methods exist, *inter alia*, we can mention Min-Max, ranking, Z-score, SoftMax, distance to a reference (OECD & Joint Research Centre, 2008). Each of these methods has its advantages and disadvantages but the results obtained are usually close, *ceteris paribus* (Tchamyou *et al*., 2022). In this study, we use the well-known min-max method among other techniques. This method is one of the most famous ways to normalize data in the literature (Diop & Asongu, 2020). Tchamyou *et al*. (2022) have already employed this method to construct an African woman vulnerability index with the Afrobarometer survey. The min-max method provides value scaled into the range $[0, 1]$ where the minimum index and the maximum index are 0 to 1, respectively. The min-max transformation is given as follows in Equation (1):

$$I_{qr} = \frac{x_{qr} - min_r(x_q)}{max_r(x_q) - min_r(x_q)} \quad (1)$$

Where $x_{qr}$is the value of indicator q for region r. The minimum and the maximum values for each indicator are calculated across different countries.

The final step is the weighting and aggregating to construct the index. Instead of using arithmetic or geometric means, in this study, we prefer the principal component analysis

(PCA) since the indicators are numeric (all data are in proportion by region). This preference can be justified by the fact that if the indicators are not equally important, the PCA works better. The objective of this method is to reduce the number of variables by elucidating the observed variance of data via the linear relation of the original data. Loadings obtained from the PCA are used to compute the different weights instead of giving the same weight to all variables as it is the cases with the arithmetic and geometric methods (Tchamyou *et al.*, 2022). Firstly, we run the PCA on the variables in each dimension in order to fit the weights. Secondly, once the weights are obtained, the 13 indexes can be constructed.

With respect to the ICT index, the same procedure is used. In this work, we construct an index of ICT based on the proportion of connected people or mobile phone owners. Three indicators are included namely: "Mobile phone access to internet", "How often internet is used" and "Own mobile phone". This composite index allows us to evaluate the relationship between ICTs and SDGs in African countries at the local-level.

3. Empirical specification

We employ a model in which the outcome variable representing the SDGs is regressed on ICTs and other control variables as apparent in Equation (2):

$$SDG_{i,j} = \alpha + \gamma_j + \beta ICT_j + \sum_{h=1}^{k} \delta_h X_{h,j} + \varepsilon_j \quad (2)$$

Where SDG_{ij} is the measure of the sustainable development goal number i in region j. ICT_j is the measure of information and communication technologies in region i while $X_{h,j}$ is a vector of regional characteristics related with SDGs such us the proportion of urban people, mean age, remittances and proportion of active members of voluntary associations and/or community group. α is the constant, γ_j captures the regional fixed effects and ε_j is the stochastic error term.

As noted previously, if ICTs is endogenous, ordinary least squares (OLS) estimations will not be consistent. In effect, ICTs and SDGs are mutually reinforcing in a reciprocal pattern. We therefore use an instrumental variable (IV) regression to address the simultaneity or reverse causality concern of endogeneity. However, finding attendant instruments which must be correlated with ICT and not SDGs is not easy. According to the existing literature, the severity of endogeneity decreases with the length of the geographic area (Dustmann & Preston, 2001). This strategy is already adopted in previous studies. For example, Churchill and Danquah (2020) use a regional level measure of ethnic diversity as an instrument to

examine the effect of ethnic diversity on informal work. In the same direction, Bertschek and Niebel (2015) use the average mobile internet use measured at the level of 51 industries to account for potential simultaneity between labour productivity and mobile internet. Such instrumentation is within the remit of assessing whether employees' use of mobile internet access improves firms' labour productivity. Thus, by instrumenting ICTs at the regional-level by ICTs with a measure from a higher geographic area (country-level), we probably define a strong instrument. In our study, we define national mobile internet access, national mobile phone ownership, national social media news access and national news or newspaper access as corresponding instruments.

4. **Results and discussion**

Before discussing the empirical results of the regression, we first present the summary statistics of the different indexes established in Table 2. For ICTs indexes, African regions exhibit a lower level on average even if we note a very large spread because the minimum value is 0.064 while the maximum value is 0.837. This finding indicates that in Africa, there is a very important gap in ICTs development between regions. Regarding the SDGs indexes, highest scores are in Goal 10 "reduce inequality" (0.660), Goal 2 "zero hunger" (0.600) and Goal 4 "quality of education" (0.515) while lowest scores are found in Goal 16 "peace, justice and strong institutions" (0.233), Goal 8 "decent work and economic growth" (0.287), and Goal 13 "climate action" (0.321). We can also note a high heterogeneity between regions for indexes of SDGs and mostly for Goal 7 "affordable and clean energy", Goal 6 "clean water and sanitation", Goal 11 "sustainable cities and communities" and Goal 8 "decent work and economic growth".

Table 3 reports OLS estimations with country dummies fixed effects. The estimated parameters associated to ICTs are positive and significant for six of the thirteen SDGs indicators (Goal 4 "Quality education", Goal 6 "Clean water and sanitation", Goal 7 "Affordable and clean energy", Goal 9 "Industry, innovation and infrastructure" and Goal 11 "Sustainable cities and communities"), insignificant for six SDGs indicators (Goal 1 "No poverty", Goal 2 "Zero Hunger", Goal 3 "Good Health and well-being", Goal 8 "Decent work and economic growth", Goal 10 "Reduce inequality" and Goal 13 "Climate action"), negative and significant for one SDG (Goal 16 "Peace, Justice and strong institutions").

However, the results provided by OLS estimates cannot be capitalized upon because they do not address some econometric problems such as endogeneity and specifically reverse causality. That is why the 2SLS-IV estimations are preferred if we are in the presence of endogeneity, especially as it pertains to the simultaneity dimension of the issue. Contrarily, if the presence of endogeneity is rejected, we turn our analysis toward the OLS estimations.

The empirical findings of the 2SLS-IV are reported in Table 4. The Durbin-Wu-Hausman test for endogeneity reveal that the ICT indicator is endogenous for six of the thirteen regressions. Hence, OLS applied on these six models are biased and therefore we prefer 2SLS-IV for interpreting these corresponding findings. The results reveal that ICTs are positive and significant on Goal 1 "No poverty", Goal 2 "Zero Hunger", Goal 6 "Clean water and sanitation", Goal 8 "Decent work and economic growth" and Goal 11 "Sustainable cities and communities". Thus, we confirm the hypothesis that ICTs could reduce poverty and hunger, improve clean water and sanitation and enhance decent work and sustainable cities. Indeed, we note that the 2SLS-IV coefficients are larger than OLS coefficients suggesting that OLS underestimates the effect of ICT on SDGs in the presence of endogeneity within the remit of simultaneity or reverse causality. The estimated coefficient on Goal 4 "Quality education" is negative and significant at 1% level.

With OLS estimations where the problem of endogeneity is not taken into account, the results indicate that ICTs effects on SDGs are positive and significant on Goal 5 "Gender equality", Goal 7 "Affordable and clean energy", Goal 9 "Industry, innovation and infrastructure" while the coefficient becomes insignificant for Goal 3 "Good Health and well-being" and Goal 10 "Reduce inequality". Another counterproductive result is noted on the relationship between ICTs and Goal 16 "Peace, Justice and strong institutions". In effect, the coefficient for this goal is negative and significant implying that ICTs cannot be considered as a catalyst to achieve this corresponding goal.

Overall, our results reveal a positive and significant effect of ICTs on eight out of thirteen SDGs (Goal 1 "No poverty", Goal 2 "Zero Hunger", Goal 6 "Clean water and sanitation", Goal 8 "Decent work and economic growth", Goal 11 "Sustainable cities and communities", Goal 5 "Gender equality", Goal 7 "Affordable and clean energy", Goal 9 "Industry, innovation and infrastructure"). Thus, ICTs can be considered as a catalyst for the achievement of these SDGs.

5. Conclusion and future research directions

Using the data from the Afrobarometer Round 7 surveys where indicators are individual interviews in 400 regions from 34 countries, we have investigated the effect of Information and Communication Technologies (ICTs) on the achievement of most Sustainable Development Goals (SDGs). More precisely, the objective of the paper has been to test if ICTs can help to accelerate progress towards the United Nations' SDGs.

Overall, according to our empirical results, ICTs are positively and significantly related with eight out of thirteen SDGs (Goal 1 "No poverty", Goal 2 "Zero Hunger", Goal 6 "Clean water and sanitation", Goal 8 "Decent work and economic growth", Goal 11 "Sustainable cities and communities", Goal 5 "Gender equality", Goal 7 "Affordable and clean energy", Goal 9 "Industry, innovation and infrastructure"). Thus, ICTs can be considered as a catalyst for the achievement of these SDGs at the local level in African countries. The findings provide several policy implications. The findings of this work indicate that investments in ICT contribute towards reducing poverty and hunger, gender inequality, enhancing decent work and innovation and infrastructure as well as improving sanitation and clean energy.

There are various directions for future research. A first way is to evaluate potential channels through which ICTs impact sustainable development. More precisely, it is important to evaluate channels like financial development as well as mechanisms related to macroeconomic indicators. Secondly, in order to learn more about how ICTs accelerate the achievement of SDGs, it is worthwhile to assess dynamics at a more disaggregated level (for example at a district level). This approach will enable local-level implementation and SDGs mainstreaming at a district level in Africa as well as provide avenues via which to conduct a detailed evaluation of sustainable development in the continent.

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Table 1: Afrobaromater SDGs selection

Goals	Official SDG explanation	Afrobarometer indicators	Value labels
Goal 1 : No poverty	End extreme poverty in all forms by 2030	Q56a. Handling managing the economy	Very well
		Q56b. Handling improving living standards of the poor	Very well
		Q56e. Handling narrowing income gaps	Very well
		Q8e. How often gone without a cash income	Never
Goal 2 : ZeroHunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Q8a. How often gone without food	Never
		Q56j. Handling ensuring enough to eat	Very well
Goal 3 : Good Health and well-being	Ensure healthy lives and promote well-being for all at all ages	EA-FAC-D. Health Clinic in the PSU/EA	Yes
		Q49g. Pay bribe for medical care	Never
		56g. Handling improving basic health services	Very well
		Q8c. How often gone without medical care	Never
		Q49e. Difficulty to obtain medical treatment	Very easy
		Q49f. Time taken to receive medical care	Right away
		Q57a. Better or worse: access to medical care	Much Better
Goal 4 : Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Q56h. Handling addressing educational needs	Fairly well
		Q57c. Better or worse: government effectiveness on education	Much Better
		Q97. Education of respondent	formal schooling
		Q77a. Girls and boys have equal chance at education	Strongly agree

		EA-FAC-B. School in the PSU/EA	Yes
Goal 5 : Gender equality	Chieve gender equality and empower all women and girls	Q38e. Women have equal right to land	Strongly agree
		Q38d. Men have more right to job	Strongly disagree,
		Q16. Men only as leaders vs. women leaders	Agree very strongly with Statement 2
		Q77c. Women and men have equal chance of paying job	Strongly agree
		Q56q. Handling promoting equal rights/opportunities for women	Fairly well
		Q86a. Experienced discrimination based on gender	Never
		Q78b. Justified for men to beat their wives	Never justified,
Goal 6: Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all	Q8b. How often gone without water	Never
		Q56i. Handling providing water and sanitation services	Fairly well
		EA-SVC-B. Piped water system in the PSU/EA	Yes
		Q92a. Source of water for household use	Inside the house
Goal 7: Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all	EA-SVC-A. Electricity grid in the PSU/EA	Yes
		Q56m. Handling providing reliable electric supply	Very well,
		Q93. Electric connection from mains	All of the time
Goal 8: Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Q94. Employment status	Yes, full time
		Q56c. Handling creating jobs	Very well,
Goal 9: Industry, innovation and	Build resilient infrastructure, promote inclusive and sustainable industrialization	EA-ROAD-A. Road surface at start point	Paved/ Tarred, Concrete

infrastructure	and foster innovation		
		EA-ROAD-B. Road surface last 5 km	Paved/ Tarred, Concrete
		Q56l. Handling maintaining roads and bridges	Very well
		BEA-FAC-F. Bank in the PSU/EA	Yes
		EA-ROAD-C. Road condition last 5 km	Very Good
Goal 10: Reduce inequality	Reduce inequality within and among countries	Q86a. Experienced discrimination based on gender	Never
		Q86c. Experienced discrimination based on ethnicity	Never
		Q42D. How often people treated unequally	Never,
		Q85. Ethnic group treated unfairly	Never
		Q86b. Experienced discrimination based on religion	Never
		Q86d. Experienced discrimination based on disability	Never,
Goal 11: Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable	EA-SVC-A. Electricity grid in the PSU/EA	Yes
		EA-SVC-B. Piped water system in the PSU/EA	Yes
		EA-SVC-C. Sewage system in the PSU/EA	Yes
		EA-FAC-C. Police station in the PSU/EA	Yes
		EA-FAC-E. Market stalls in the PSU/EA	Yes
		BEA-FAC-F. Bank in the PSU/EA	Yes
		EA-ROAD-A. Road surface at start point	Paved/ Tarred
Goal 12:	Ensure sustainable consumption and	----	----

Responsible consumption and production	production patterns		
Goal 13: Climate action	Take urgent action to combat climate change and its impacts	Q72a. Severity of droughts	Much less severe
		Q72b. Severity of flooding	Much less severe
		Q73a. Heard about climate change	Yes
		Q71. Climate conditions compared to ten years ago	Better
		Q75. Climate change: affecting country	Much worse
Goal 14: Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	----	----
Goal 15: Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	----	----
Goal 16: Peace, Justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Q43g. Trust police	A lot
		Q43i. Trust courts of law	A lot
		Q44b. Corruption: Members of Parliament	None
		Q44d. Corruption: local government councillors	None
		Q44e. Corruption: police	None
		Q44f. Corruption: judges and magistrates	None
		Q45. Level of corruption	Decreased a lot
		Q48d. Rich person: pay bribe to avoid taxes	Not at all likely

		Q48e. Rich person: pay bribe to avoid going to court	Not at all likely
		Q48f. Rich person: pay bribe to register land not theirs	Not at all likely
Goal 17: Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development	----	----

Source : authors from Round 7 Afrobarometer Survey

Table 2: Descriptive statistics on indexes

	Obs.	Mean	Std. Dev	Min	Max
Index of Information and Communication Technology (ICTs)					
ICT index	400	0.357	0.150	0.064	0.837
Index of Sustainable Development Goals (SDGs)					
Goal 1 : No poverty	400	0.361	0.110	0.080	0.800
Goal 2 : Zero Hunger	400	0.600	0.128	0.053	0.928
Goal 3 : Good Health and well-being	400	0.414	0.110	0.158	0.797
Goal 4 : Quality education	400	0.515	0.088	0.275	0.840
Goal 5 : Gender equality	400	0.487	0.113	0.212	0.821
Goal 6: Clean water and sanitation	400	0.345	0.146	0.088	0.746
Goal 7: Affordable and clean energy	400	0.416	0.211	0.025	0.977
Goal 8: Decent work and economic growth	400	0.287	0.144	0.000	0.763
Goal 9: Industry, innovation and infrastructure	400	0.319	0.138	0.062	0.811
Goal 10: Reduce inequality	400	0.660	0.098	0.131	0.838
Goal 11: Sustainable cities and communities	400	0.401	0.154	0.121	0.859
Goal 13: Climate action	400	0.321	0.103	0.089	0.769
Goal 16: Peace, Justice and strong institutions	400	0.233	0.110	0.031	0.755

Source: Authors' calculation on data from Round 7 Afrobarometer Survey

Table 3: OLS Estimations

	No poverty	Zero_Hunger	Good_health	Quality_educ	Gender_equ	Clean_water	Affor_energy
ICT_index	-0.035 (0.528)	-0.003 (0.953)	-0.015 (0.798)	0.086** (0.015)	0.174*** (0.008)	0.283*** (0.000)	0.349*** (0.000)
Urban	-0.015 (0.522)	-0.005 (0.817)	0.027 (0.302)	0.012 (0.564)	-0.006 (0.796)	0.122*** (0.000)	0.239*** (0.000)
Age	0.003* (0.098)	0.001 (0.516)	0.000 (0.666)	0.000 (0.769)	0.003** (0.035)	0.004* (0.053)	0.002 (0.323)
Community	-0.017 (0.762)	-0.044 (0.467)	-0.018 (0.732)	-0.025 (0.610)	0.025 (0.695)	-0.067 (0.242)	-0.132 (0.100)
Remittance	0.259* (0.06)	0.073 (0.583)	0.100 (0.476)	0.011 (0.928)	-0.095 (0.444)	0.272* (0.078)	0.618*** (0.006)
Constant	0.270*** (0.000)	0.592*** (0.000)	0.400*** (0.000)	0.488*** (0.000)	0.400*** (0.000)	0.068 (0.163)	0.013 (0.833)
AdjustedR^2	0.512	0.591	0.504	0.418	0.541	0.699	0.723
Observations	400	400	400	400	400	400	400
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3 continued…

ICT_index	Dec_work	Indus_innov	Red_ineq	Sust_cities	Climate_act	Peace_just
Urban	0.089 (0.232)	0.280*** (0.000)	-0.028 (0.704)	0.241*** (0.002)	0.108 (0.114)	-0.153*** (0.005)
Age	0.020 (0.500)	0.146*** (0.000)	-0.005 (0.851)	0.246*** (0.000)	0.022 (0.367)	-0.046** (0.039)
Community	0.002 (0.301)	0.001 (0.405)	0.005*** (0.000)	0.000 (0.860)	0.001 (0.551)	0.002 (0.203)
Remittance	-0.073 (0.410)	-0.154** (0.016)	-0153* (0.057)	-0.092 (0.115)	0.094 (0.165)	0.128** (0.017)
Constant	0.149 (0.291)	0.301** (0.039)	0.103 (0.376)	0.595*** (0.000)	-0.271** (0.048)	0.163 (0.377)

Adjusted R^2	0.158*** (0.000)	0.113*** (0.007)	0.547*** (0.000)	0.096** (0.016)	0.206*** (0.000)	0.232*** (0.000)
Observations	0.623	0.622	0.479	0.708	0.392	0.525
Country dummies	400	400	400	400	400	400

Robust standard errors in parentheses *p<0.10, **p<0.05, ***P<0.01. No poverty (Goal 1 : No poverty); Zero_Hunger (Goal 2 : Zero Hunger); Good_health (Goal 3 : Good Health and well-being); Quality_educ (Goal 4 : Quality education); Gender_equ (Goal 5 : Gender equality); Clean_water (Goal 6: Clean water and sanitation); Affor_energy (Goal 7: Affordable and clean energy); Dec_work (Goal 8: Decent work and economic growth); Indus_innov (Goal 9: Industry, innovation and infrastructure); Red_ineq (Goal 10: Reduce inequality); Sust_cities (Goal 11: Sustainable cities and communities); Climate_act (Goal 13: Climate action) ; Peace_just (Goal 16: Peace, Justice and strong institutions).

Table 4: 2SLS IV estimations

	No poverty	Zero_Hung	Good_health	Quality_educ	Gender_equ	Clean_water	Affor_ener
ICT_index	0.246*** (0.001)	1.016*** (0.000)	0.015 (0.849)	-0.247*** (0.000)	0.124 (0.189)	0.796*** (0.000)	-0.119 (0.106)
Urban	-0.010 (0.784)	-0.259*** (0.000)	0.060 (0.101)	0.115*** (0.000)	0.014 (0.732)	0.005 (0.897)	0.108*** (0.001)
Age	0.004*** (0.004)	0.001*** (0.005)	0.005*** (0.000)	-0.000 (0.983)	0.007*** (0.000)	0.010*** (0.000)	0.006*** (0.000)
Community	0.271*** (0.000)	0.032 (0.590)	0.053 (0.284)	0.145*** (0.000)	0.148*** (0.005)	-0.023 (0.703)	0.160*** (0.002)
Remittance	0.258** (0.041)	-0.540*** (0.005)	0.106 (0.422)	0.137 (0.185)	0.232* (0.068)	-0.194 (0.183)	0.359*** (0.000)
Constant	0.136*** (0.000)	0.239*** (0.000)	0.267*** (0.000)	0.518*** (0.000)	0.253*** (0.000)	-0.130*** (0.001)	0.313*** (0.000)
Weak identification tests							
Cragg-Donal Wald F Statistic	92.415	49.485	152.429	152.429	49.485	88.805	125.598
Kleibergen-Paaprk Wald F Statistic	137.726	38.210	155.195	155.195	38.210	114.303	142.707

Stock and Yogo Critical Value (10%)	19.930	19.930	19.930	19.930	19.930	19.930	19.930
Endogeneity test							
Durbin-Wu-Hausman *Chi2 (1)*	4.432**	46.475***	0.066	7.519***	0.064	35.761***	1.180
Wu-Hausman F (*1,N*)	4.461**	42.300***	0.067	7.509***	0.062	33.362***	1.197
Hansen-J test of overidentification							
Hansen Statistic	2.311	0.218	2.200	0.218	10.906	4.242	0.020
P-value	0.128	0.641	0.138	0.641	0.001	0.120	0.887
Observations	400	400	400	400	400	400	400

Table 4 continued…

	Dec_work	Indus_innov	Red_ineq	Sust_cities	Climate_act	Peace_just
ICT_index	0.395***	0.319***	-0.143***	0.628***	0.033	-0.183***
	(0.000)	(0.002)	(0.006)	(0.000)	(0.621)	(0.003)
Urban	-0.068	0.175***	0.011	0.158***	0.009	-0.032
	(0.122)	(0.000)	(0.696)	(0.000)	(0.784)	(0.278)
Age	0.005***	0.000	0.008***	0.001	-0.002	0.004***
	(0.007)	(0.753)	(0.000)	(0.281)	(0.235)	(0.004)
Community	0.228***	0.045	-0.168***	-0.061	0.150***	0.023
	(0.000)	(0.354)	(0.000)	(0.200)	(0.005)	(0.613)
Remittance	-0.258	-0.136	0.450***	-0.184	-0.214	0.551***
	(0.238)	(0.390)	(0.000)	(0.231)	(0.109)	(0.002)
Constant	0.032	0.117**	0.552***	0.100***	0.321***	0.204***
	(0.549)	(0.01)	(0.000)	(0.005)	(0.000)	(0.000)
Weak identification tests						
Cragg-Donal Wald F Statistic	108.916	108.916	108.916	125.598	90.653	120.252
Kleibergen-Paaprk Wald F Statistic	148.040	148.040	148.040	142.707	100.339	157.272
Stock and Yogo Critical Value (10%)	19.93	19.93	19.93	19.93	19.93	19.93
Endogeneity						

Durbin-Wu-Hausman *Chi2 (1)*	12.973***	2.571	0.004	13.617***	0.186	0.402
Wu-Hausman *F (1,N)*	12.783***	2.600	0.003	13.395***	0.189	0.408
Hansen-J test of overidentification						
Hansen Statistic	0.004	0.011	2.697	0.948	1.027	0.323
P-value	0.948	0.916	0.100	0.330	0.311	0.569
Observations	0.005	0.348	0.253	0.545	0.040	0.140

Robust standard errors in parentheses *p<0.10, **p<0.05, ***P<0.01. No poverty (Goal 1 : No poverty); Zero_Hunger (Goal 2 : Zero Hunger); Good_health (Goal 3 : Good Health and well-being); Quality_educ (Goal 4 : Quality education); Gender_equ (Goal 5 : Gender equality); Clean_water (Goal 6: Clean water and sanitation); Affor_energy (Goal 7: Affordable and clean energy); Dec_work (Goal 8: Decent work and economic growth); Indus_innov (Goal 9: Industry, innovation and infrastructure); Red_ineq (Goal 10: Reduce inequality); Sust_cities (Goal 11: Sustainable cities and communities); Climate_act (Goal 13: Climate action) ; Peace_just (Goal 16: Peace, Justice and strong institutions). Mobile internet, own mobile, social media, internet news at country level are used as instruments.