

# The Impact of ICT on Terrorism in African Countries

## ABSTRACT:

Although the macroeconomic effects of information and communication technology (ICT) has been a topic of many debates in the literature over the past 20 years, the effect of ICT on terrorism is still largely unexplored. Using the Generalized Method of Moments (GMM) technique, this paper investigates the impact of ICT on terrorism on a panel of 49 African countries over the period 1998-2012. Two ICT indicators (Internet and Mobile) and four different but linked terrorism indicators (Domestic, transnational, unclear and total terrorisms) are used. The paper finds a significant positive effect of ICT on terrorism.

*Keywords: ICT; terrorism; Panel data; Africa*

**JEL classification codes:** C33 ; D74 ; L96 ; O55

## 1. INTRODUCTION

Over the years, terrorism has become the most important challenge to peace, security and development in the world and Africa is becoming a field where terrorist groups flourish. With Al-Qaeda in the Islamic Maghreb, Boko Haram in Nigeria and Cameroon, Al-Shabab in Somalia and ISIS in North and Southern Africa, the terror activities have grown exponentially in the continent not only in terms of the number of attacks but also the number of countries affected (RuchitaBeri, [1]). In the literature on terrorism, this proliferation of terrorist groups is linked, particularly to the high level of corruption, the failure of governments, the abundance of natural resources, ethnic and tribal tensions and religious fundamentalism (Fazel[2];Alfa-Wali, Sriharan, Mehes, Abdullah, and Rasheed [3]; Asongu and Nwachukwu, [4]).

According to the Global Terrorism Index (GTI 2014), the terrorist attacks attributed to the Boko Haram Islamic group in Nigeria cost more than 6,644 lives lost, compared to the 6,073 deaths caused by the Islamic State in Iraq. (ISIS). This figure, which concerns only one country and one terrorist group, sufficiently reveals the rise of terrorist groups in Africa and especially the need for African states to curb this scourge. To deal with terrorists, African states and international organisations have spent hundreds of billions of dollars arming and recruiting tens of millions of soldiers. All these efforts have helped to reduce, but not eradicate terrorist attacks. In recent years, digital, through the development of information and communication technologies (ICT) offers an effective way for governments to

fight against terrorism.

Since the years 2000, developing countries, and particularly Africa has experienced a rapid diffusion of ICTs. Indeed, the average proportion of individuals with internet access in Sub-Saharan Africa (SSA) has increased from 0.84% of the population in 2000 to more than 17% in 2015 (ITU, [5]). The sector with the highest growth is mobile telephony. Far from being a luxury goods, the mobile phone is now one of the most consumed on the continent. Between 2000 and 2015, the number of subscriptions to mobile phone increased from 11 million over 750 million, representing a penetration rate of 83.11% [5]. The rapid growth of the use of mobile phones can also explain that of the internet.

The development of ICTs with the popularization of the internet and the large-scale use of mobile phones have allowed governments around the world to track terrorists more quickly and cheaply and save millions of lives. Digital counter-terrorism initiatives are expanding around the world, with projects such as "Tech Against Terrorism". However, the development of ICTs facilitates not only the sharing of information between countries, but also communication between terrorist groups, facilitating their propaganda and the recruitment of followers on social networks, and internationalized terrorism all over the world. According to UNODC [6] the primary use of internet by the terrorist is for propaganda in the form of multimedia communications providing ideological or practical instructions, explanations, justifications or promotion of terrorist activities. This line of reasoning leads to the conjecture that the

development of ICT is beneficial for terrorist groups and thus increase terrorist activities. Do we have any empirical evidence to support this conjecture?

This paper contributes to the literature in several ways: (i) Previous studies on the ICT and terrorism relationship are mostly qualitative studies than quantitative. This paper empirically investigates in the African context the effect of ICT on terrorism. (ii) The previous studies have considered only one component of ICT, notably internet. This paper considers the role of the mobile phone penetration which remains the most used means to communicate in Africa. (iii) The previous work took into account only two variables of terrorism namely domestic and transnational terrorism. However, the development of ICT can have detrimental effects that are not taken into account in the measurement of domestic and transnational terrorisms. This paper extends the existing literature by considering four but connected terrorism indicators, namely domestic, transnational, unclear and total terrorisms. (vi) Given the number of countries affected by terrorist attacks around the world and particularly in Africa, this study examines the effect of ICTs in a panel of 49 African countries over the period 1998-2012. Applying the system Generalized Moments method, the results show that ICTs measured by internet penetration and mobile penetration have a positive and significant effect on the four measures of terrorism.

The rest of this paper is organised as follows: in Section 2 we discuss the theoretical framework and empirical literature on the effect of ICT on terrorism. In Section 3 we present data and methodology. Our main empirical results are discussed in Section 4. Section 5 concludes.

## 2. THEORETICAL FRAMEWORK AND EMPIRICAL LITERATURE

The literature has not provided a consistent theoretical framework that explains the link between information and communication technology (ICT) and terrorism. However, the theoretical argument of this study is based on the cybernetic theory developed by Wiener [7] which poses as the sciences of interaction on which the communication theory developed by Shannon [8] is anchored on. The theory of cybernetics is interesting for this study because it allows the person receiving the information to process it, to react or modify the information to better perform the tasks related to terrorist acts. As we said above, international terrorism is based on a network of interaction and communication between the different dormant cells. Therefore, the information received by the different terrorist cells abroad are processed and executed according to instructions coming from the terrorist group (information flow). The information transmitted by terrorist groups such as Al-Qaida circulates through the means of communication such as Facebook, WhatsApp, Instagram or You

Tube. Thus, cybernetic theory seems more appropriate to understand how ICT development serves as a channel of communication to different terrorist groups.

A large body of literature studies both the micro- and macroeconomic effects of ICT, using time series, cross-sectional and panel data analysis. Microeconomic research demonstrates that ICT development facilitate health intervention (Zhang, Li, Qiao, Zhou, and Shen[9]), improve education (Rubagiza, Were, and Sutherland, [10]) and make learning environment alive and more attractive (Cuncka and Savicka, [11]). Evidence of the macroeconomics effects of ICT show that ICT favour innovation and competitiveness (Ollo-López and Aramendia-Muneta, [12]), enhance living standard (Chavula, [13]), improve the energy performance (Morán, Profaizer, Zapater, Valdivia, and Bribián, [14]), improve welfare externalities (Carmody, [15]), reduce inequality (James, [16]), and boost inclusive human development (Asongu and Le Roux,[17]). The evidence on the effect of ICT on economic growth is mixed, with some studies showing a positive effect on economic growth (Neibel[18]; Vu 2013) while others do not find such influence (Ishida [19]; Yousefi[20]; Pohjola[21]). While ICT has been proved to reduce corruption by increasing the certainty and celerity of punishments for corruption (Bhattacharjee and Shrivastava[22]; Ali and Gasmi[23]), others studies have cast doubt on how effective ICT really is in reducing corruption (Garcia-Murillo[24]; Charoensukmongkol and Moqbel[25]). Moreover, recent research demonstrates that ICT development also has a detrimental effect on environment, as ICT can damage environmental sustainability by increasing CO2 emissions (Higón, Gholami, and Shirazi[26]).

Despite this active literature on ICT, to the best of our knowledge there are only few studies which examine the impact of ICT on terrorism, particularly in African context. Moreover, the works that are interested in this topic are more qualitative than analytical. Jefferson [27] analyses the use of ICTs in regional conflicts, war and terrorism. It details some of the most common uses of ICT. It gives examples of the role ICTs have in influencing public opinion and foreign policy and conducting military, terrorist, and aid operations. For example, in 1998, while only less than half of the 30 armed groups classified as "Foreign Terrorist organizations" (FTOs) by the US State Department had a website, within one year almost all of them did (Hoffman[28]). This figure shows how ICT development has fostered the development and presence of terrorist groups on social networks. This permanent presence of these different groups promotes their propaganda, facilitates the raising of funds and the recruitment of followers. Keene [29] highlight the extent of the use of the internet by a terrorist organisation to achieve their strategic and operational objectives. Through an extensive literature on notions such

as Islamic terrorism, cybercrime and financial crime, the author shows that Al-Qaida has become a radical and international terrorist group by its ability to communicate with its global network of communities through the internet. This ability to communicate remotely with dormant cells in many parts of the world facilitates the sharing of knowledge, facilitates recruitment, and plays an important role in spreading the propaganda of its ideology. Several other studies have attempted to examine how far media technologies through internet are transforming the nature of risk in contemporary society (Anderson[30]) and how terrorist used internet (Lachow and Richardson [31]; Weimann[32], without however focussing on the empirical effect

of ICT on terrorism. This paper contributes to this literature by investigating the empirical effect of ICT on terrorism in African countries.

### 3. DATA AND EMPIRICAL MODEL

#### 3.1. Data

This paper examines a panel of 49 African countries over the period 1998-2012 with data from Enders, Sandler, and Gaibulloev[33], Gaibulloev, Sandler, and Santifort[34], Polity IV project (Marshall and Jaggers[35]), and The World Bank (WDI and WGI). The sample and periodicity are constrained by data availability. The full description of the data is as follows:

Table 1 : Definitions and source of variables

Variables	Signs	Variable definitions (measurement)	Sources
Internet	Internet	Internet subscriptions (per 100 people)	
Mobile	Mobile	Mobile phone subscriptions (per 100 people)	Ender et al. [33]
Domestic terrorism	Domter	Number of Domestic terrorism incidents	and
Transnational terrorism	Transter	Number of Transnational terrorism incidents	Gaibulloev et al. [34]
Unclear terrorism	Unclear	Number of terrorism incidents whose category is unclear	
Total terrorism	Totter	Total number of terrorism incidents	
Remittances	Remit	Personal remittances, received (% of GDP)	World Bank (WDI)
Foreign aid	ODA	Net ODA received (% of GNI)	World Bank (WDI)
Education	Educ	School enrolment, secondary, female (% gross)	World Bank (WDI)
Foreign direct investment	FDI	Foreign direct investment, net inflows (% of GDP)	World Bank (WDI)
Political Stability	PS	"political stability/no violence (estimate): measured as the percentage of the likelihood that the government will be destabilized or overthrown by unconstitutional and violent means, including domestic violence and terrorism". This indicator reflects the openness and the competitiveness of	World Bank (WGI)
Polity2	Polity2	the political process as well as the presence of institutions that foster political participation. It ranges from 0 to 10, where a higher rating implies higher levels of democracy	Polity IV Project

WDI: World Development Indicators. WGI: World Governance Indicators.

The dependent variables are four different but connected terrorism indicators, namely: (i) domestic terrorism, (ii) transnational terrorism, (iii) unclear terrorism and, (iv) total terrorism. Terrorism indicators are defined according to Efobi et al.[36] Domestic terrorism "include all incidences of terrorism that involves nationals of the venue country: implying that the perpetrators, the victims, the targets and supporters are all from the venue country". Transnational terrorism is "terrorism including those acts that concern at least two countries". Unclear terrorism is that, "which constitutes incidences of terrorism that can neither be defined as domestic nor transnational terrorism". Total terrorism is the

sum of domestic, transnational, and unclear terrorism. These four terrorism indicators are increasingly used in the literature on terrorism (Asongu and Nwachukwu[37]).

The information and communication technologies (ICT) independent variables from World development indicators are: the internet penetration and mobile phone penetration. These two variable are chosen according to the literature on ICT in African (Ali and Gasmi[38]; Haftu[39]). Figure 1 and 2 suggest a positive correlation between ICT and terrorism indicators. However, as correlation does not mean causality, these relationships will be investigated empirically.

Table 2: Summary statistics and list of countries

Panel A : summary statistics

	Variable	Obs	Mean	S.D.	Min	Max
Terrorism	Domesticterrorisms	735	0.385	0.832	0.000	6.234
	Transnational terrorism	735	0.188	0.483	0.000	3.332
	Unclearterrorism	735	0.059	0.255	0.000	3.091
	Total terrorism	735	0.486	0.919	0.000	6.301
ICT	Internet penetration	725	4.266	7.424	0.000	55.416
	Mobile phone penetration	731	24.320	31.061	0.000	187.355
Control variables	Polity2	734	1.184	5.252	-9.000	10.000
	PoliticalStability	637	-0.555	0.880	-2.986	1.186
	Remittances	530	3.992	7.515	0.000	61.993
	Foreignaid	680	10.714	13.572	-0.253	181.187
	Education	450	39.072	23.439	5.186	101.615
	FDI	730	4.904	8.693	-5.980	91.007

Panel B: list of countries

Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Dem, Rep, Congo, Rep, Cote d'Ivoire, Djibouti, Egypt, Equatorial-Guinea, Eritrea, Ethiopia, Gabon, Gambia, The Gambia, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

Next to ICTs variables, we include six control variables, notably: (i) Polity2 from Polity IV project to capture democracy, (ii) Political stability from World Governance Indicators, (iii) remittances, (iv) foreign aid, (v) education, and (vi) foreign direct investment from World Development Indicators (WDI). We discuss expected signs of control variables in the following.

Table 3: Correlation matrix

	Terrorism				ICT		Control variables					
	Domter	Transter	Unter	Totter	Internet	Mobile	Polity2	PS	Remit	ODA	Educ	FDI
Domter	1.000	0.572	0.537	0.959	0.040	0.063	-0.071	-0.478	0.080	-0.078	0.076	-0.117
Transter		1.000	0.576	0.743	0.113	0.089	-0.079	-0.443	0.021	-0.116	-0.010	-0.046
Unter			1.000	0.610	0.010	0.017	-0.010	-0.270	0.012	-0.092	-0.017	-0.040
Totter				1.000	0.053	0.060	-0.085	-0.534	-0.081	-0.093	0.039	-0.112
Internet					1.000	0.585	-0.055	0.131	-0.007	-0.073	0.374	-0.004
Mobile						1.000	0.158	0.249	0.010	-0.299	0.609	0.123
Polity2							1.000	0.394	0.208	0.024	0.228	0.111
PS								1.000	0.155	-0.106	0.354	0.076
Remit									1.000	-0.074	0.008	0.242
ODA										1.000	-0.525	0.243
Educ											1.000	0.067
FDI												1.000

Domter: Domestic terrorism. Transter: Transnational Terrorism. Unter : unclear terrorism. Totter: Total terrorism. Internet: internet penetration. Mobile: Mobile phone penetration. PS: Political stability. Remit: remittances. ODA: foreign aid. Educ : Education. FDI : foreign direct investment.

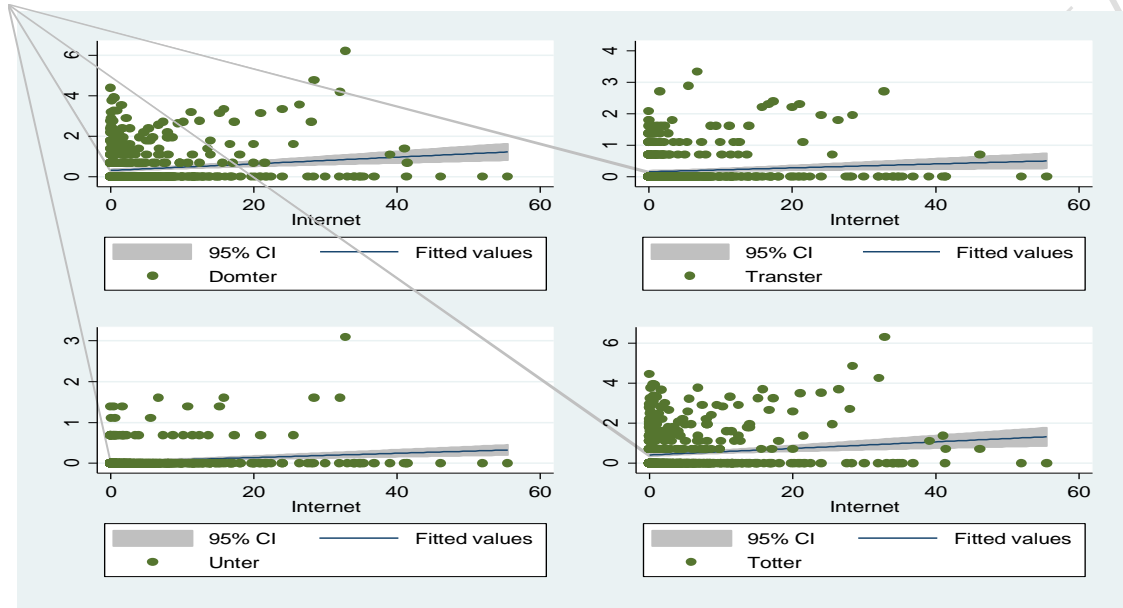
First, while Berrebi[40] has proved that education is positively correlated with terrorism, as terrorist organisations are willing to recruit educated people for their ability to understand and

accomplish tasks quickly, others studies underline the negative or insignificant impact of education on terrorism (Azam and Thelen[41]; Tavares[42]). Second, Rehman and Vanin[43]

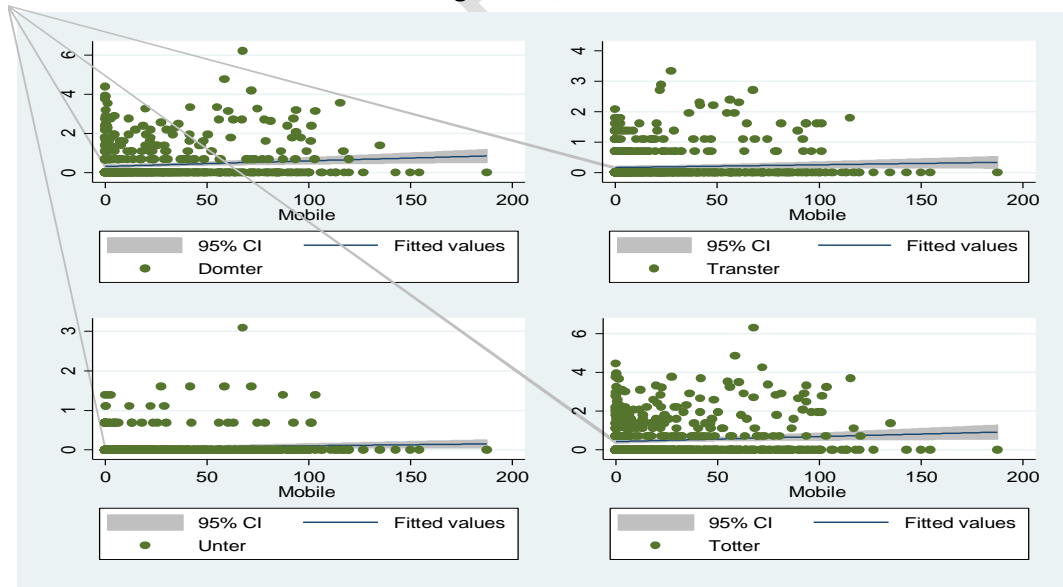
find that democracy is negatively associated to terrorism and violence. However, Eubank and Weinberg [44] documented that democracy is linked with the presence of terrorism. Third, while Elu and price [45] find that remittances finance terrorism, the results of Mascarenhas and Sandler [46] relativize the role of remittances in terrorist financing in Sub-Saharan Africa. Four, we expected a negative relationship between foreign direct investment and terrorism (Mascarenhas and Sandler[46]) and between

political stability and terrorism (Asongu and Biekpe[47]). Five, the effect of foreign aid on terrorism is mixed. While Azam and Delacroix [48] find a positive link between foreign aid and terrorism, Azam and Thelen[41] have proved that foreign aid reduce terrorism. The definition of all the variables is presented in Table 1 while Table 2 and 3 present respectively the descriptive statistics with the list of countries and the correlation matrix.

**Figure 1: Internet and terrorism**



**Figure 2: Mobile and terrorism**



Source: Author

### 3.2. Methodology

The aim of this paper is to examine the effect of

information and communication technology (ICT) on terrorism on a panel of 49 African countries over the period 1998-2012. For this purpose we

estimate the following model:

$$Terror_{it} = \alpha + \beta_1 Terror_{it-1} + \beta_2 ICT_{it} + \beta_3 X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

Where  $Terror_{it-1}$  is the terrorism variable for country  $i$  in period  $t$ .  $ICT_{it}$  is the information and communication technology (internet penetration and mobile phone penetration).  $X_{it}$  is a vector which includes all control variables.  $\mu_i$  is an unobserved country-specific effect,  $v_t$  is time specific effect and  $\varepsilon_{it}$  is the error term.

To estimate Eq (1), this paper applies the System Generalized Method of Moment (GMM) proposed by Arellano and Bond [49], Arellano and Bover[50], and Blundell and Bond [51]. GMM is useful for several reasons. First, GMM estimator has been widely used to address the endogeneity problem that appears in panel data estimation (Arellano and Bover[50] and Blundell and Bond[51]). Second, GMM estimator also take into account the biases that appear due to country-specific effects. Third, GMM also avoids simultaneity or reverse causality problems. The consistency of the GMM estimator depends on two things: the validity of the assumption that the error term does not exhibit serial correlation (AR(2)) and the validity of the instruments (Hansen test).

GMM method has two variant namely, the one-step estimators and two-step estimators. However, the two-step estimator has been proved to be more efficient than the one-step estimator because it uses optimal weighting matrices. Therefore, this paper applies the two-step system GMM. However, the use of two-step estimator to a small cross-section dimension may lead to biased standard errors (Arellano and Bond, [49]; Roodman, [52]). To correct this bias, the Arellano and Bover[50] extension by Roodman[52, 53] is applied. This estimation strategy uses forward orthogonal deviations in place of first differences. GMM with forward orthogonal deviation has been proved to account for cross-sectional dependence and to limit instruments proliferation.

#### 4. EMPIRICAL RESULTS AND DISCUSSION

We report the empirical results obtained in Table 4-5. While Table 4 displays the results of the effect of ICT (internet and Mobile phone penetration) on domestic and transnational terrorisms, Table 5 presents the impact of ICT on unclear and total terrorisms. All the diagnostic statistics are satisfactory in these tables. Specifically, the Arellano -Bond test for autocorrelation supports the validity of our system GMM model and the Hansen OIR test does not reject the over-identification restrictions. Too many instruments can severely bias and weaken the Hansen OIR restrictions and therefore, the

number of countries should be greater than the number of instruments (Roodman[53]). The GMM estimates generated around 35 instruments which are lower than the number of countries (49 in this study), hence regression results are free from instruments proliferation. Moreover, the coefficients associated with the lagged dependent variable are positive and statistically significant in all the columns. Thus we conclude from the diagnostic statistics that the System GMM is an appropriate estimator for our analysis. The results are presented through 12 columns. Columns (1) through (3) and (4) through (6) present the effects of Internet and Mobile on domestic terrorism, while Columns (7) through (9) and (10) through (12) display the influence of Internet and Mobile on transnational terrorism. In each model, the first column presents the baseline model explaining the effect of ICT on terrorism adding no control variables and the rest of the columns is the extension of the baseline model.

The following findings are established from Table 4. First, the baseline model reported in columns (1), (4), (7) and (10) shows that all ICT dynamics have a positive and statistically significant effect on domestic and transnational terrorisms, with the positive magnitudes higher from internet compared to mobile phone penetration. This result suggests that the increasing development of information and communication technologies in all African countries, while beneficial to the economy, is used by armed groups to perpetrate terrorist attacks, both nationally and internationally. This result is in line with the opinion of social scientists, political economists and defense analysts who argue that media exposure through ICT plays an important role in the promotion of terrorist activities (Lewis[54]; Jetter[55]). Second, this result is robust with the introduction of control variables. The coefficients associated with remittances are positive and statistically significant, meaning that remittances received instead of being used for consumption or investment are used to finance terrorism. This result is consistent with Elu and price [45] who find that approximately one terrorist incident is financed in Sub-Saharan Africa by remittances. The coefficients of polity2 is negative and significant in all models, suggesting that democracy reduce terrorism. This result is in accordance with Rehman and Vanin[43] who find that support for democracy is negatively associated to exposure to terrorism and violence. This means that African countries should accelerate the effective implementation of democracy, which is accompanied by the establishment of quality institutions. This result justifies the negative sign of political stability. Finally the effect of foreign aid on terrorism is

negative but insignificant. This is consistent with the findings of Nasir, Rehman, and Orakzai[56].

Table 5 extends the results obtained in Table 4 by examining the effect of ICTs on two new terrorism variables, namely unclear and total terrorisms. Once again the coefficients associated with ICT penetration are negative and statistically significant at 1% level, meaning that both internet and mobile phone penetration increase unclear and total terrorisms in African countries. Additionally, the control variables have the expected signs. While democracy and political stability are negatively correlated to terrorism, remittances increase terrorisms. The impact of foreign aid on terrorism is still insignificant.

We check how robust our results are by using more additional control variable. For this purpose, we incorporate two additional control variables, namely secondary education and foreign direct investment. The results presented in Table 6 are qualitatively similar to these reported in Tables 4-5. The coefficients associated with ICT variables are positive and statistically significant at 1% level, meaning that internet and mobile increase terrorism in African countries. The results show that in addition to our core independent variable ICT which once again has a highly significant positive effect on all four terrorism indicators, the new control variables, education and foreign direct investment have the expected signs and are highly statistically significant. Higher is education rate, particularly secondary school, lower is the level of domestic, transnational, unclear and total terrorism. This result is consistent with Tavares [42] who found that higher illiteracy is more related to terrorism in developing countries, and that higher education can be a useful tool to decrease the intensity of terrorism. Additionally the entry of multinational firms represented by foreign direct investment is associated with a lower level of terrorism. This result is justified by the fact that in order to attract foreign investors, African governments must establish a favourable framework for investment, including the fight against terrorism.

Table 4: The effect of ICT on terrorism (Domestic and Transnational terrorisms)

Dependent variable : Terrorism												
	Domestic terrorism						Transnational terrorism					
	Internet		Mobile				Internet			Mobile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<b>Internet</b>	0.0164*** (0.00251)	0.0105*** (0.00280)	0.0123*** (0.00150)				0.00260** (0.00124)	0.00473*** (0.000966)	0.00762*** (0.00134)			
<b>Mobile</b>				0.00216** (0.00102)	0.00302*** (0.000727)	0.00319*** (0.00107)				0.000712** (0.000318)	0.00184*** (0.000541)	0.00362*** (0.000564)
<b>Polity2</b>		-0.0222* (0.0114)	-0.0367*** (0.0120)		-0.0368*** (0.0132)	-0.0389** (0.0171)		-0.0183*** (0.00423)	-0.0546*** (0.0118)		-0.00969* (0.00562)	-0.0608*** (0.0127)
<b>Political stability</b>			-0.271*** (0.0385)			-0.440*** (0.0460)			-0.198*** (0.0411)			-0.255*** (0.0395)
<b>Remittances</b>			0.0284*** (0.0104)			0.0543*** (0.0171)			0.0334*** (0.00988)			0.0451*** (0.0145)
<b>Foreign aid</b>			<b>-0.00409</b> <b>(0.00321)</b>			<b>-0.00217</b> <b>(0.00609)</b>			<b>-0.00180</b> <b>(0.00232)</b>			<b>-0.00426</b> <b>(0.00419)</b>
<b>L. Dependent</b>	0.382*** (0.0302)	0.642*** (0.0223)	0.269*** (0.0146)	0.352*** (0.0374)	0.664*** (0.0164)	0.385*** (0.0345)	0.104*** (0.0282)	0.140*** (0.0161)	0.257*** (0.0199)	0.493*** (0.0228)	0.166*** (0.0177)	0.256*** (0.0261)
<b>Constant</b>	0.0934*** (0.0211)	0.0799*** (0.0214)	<b>0.0566</b> <b>(0.0870)</b>	0.0964*** (0.0227)	0.0673*** (0.0219)	<b>0.0833</b> <b>(0.129)</b>	0.0830*** (0.0186)	0.117*** (0.0166)	<b>0.0662</b> <b>(0.0892)</b>	0.0430*** (0.00972)	0.0756*** (0.0206)	<b>-0.0910</b> <b>(0.0633)</b>
<b>Observations</b>	<b>676</b>	<b>675</b>	<b>412</b>	<b>682</b>	<b>681</b>	<b>414</b>	<b>676</b>	<b>675</b>	<b>412</b>	<b>682</b>	<b>681</b>	<b>414</b>
<b>Countries</b>	<b>49</b>	<b>49</b>	<b>43</b>	<b>49</b>	<b>49</b>	<b>43</b>	<b>49</b>	<b>49</b>	<b>43</b>	<b>49</b>	<b>49</b>	<b>43</b>
<b>AR(1)</b>	<b>2.80e-05</b>	<b>2.61e-05</b>	<b>0.00111</b>	<b>8.40e-05</b>	<b>3.34e-05</b>	<b>0.000258</b>	<b>0.00163</b>	<b>0.000754</b>	<b>0.00440</b>	<b>0.000915</b>	<b>0.00106</b>	<b>0.00484</b>
<b>AR(2)</b>	0.104	0.198	0.196	0.196	0.147	0.102	0.128	0.172	0.117	0.105	0.177	0.191
<b>Instruments</b>	<b>22</b>	<b>23</b>	<b>30</b>	<b>20</b>	<b>26</b>	<b>30</b>	<b>17</b>	<b>33</b>	<b>30</b>	<b>22</b>	<b>26</b>	<b>30</b>
<b>Hansen OIR</b>	0.506	0.406	0.549	0.453	0.426	0.120	0.543	0.339	0.922	0.123	0.359	0.537



Fisher 111.8\*\*\* 293.3\*\*\* 286.5\*\*\* 51.84\*\*\* 737.3\*\*\* 160.0\*\*\* 8.067\*\*\* 96.46\*\*\* 63.10\*\*\* 254.1\*\*\* 63.80\*\*\* 145.9\*\*\*

Note:\*\*\*,\*\*,\*. Significance levels at 1%, 5% and 10% respectively. Standard errors reported in parenthesis. The significance of bold values is twofold. 1) The significance of estimated coefficients and Wald statistics. 2) The failure to reject the null hypothesis of: a) no autocorrelation in the AR (2) tests and; b) the validity of the instruments in the Hansen OIR tests.

Table 5: The effect of ICT on terrorism (Unclear and Total terrorisms)

Dependent variable : Terrorism												
	Unclearterrorism						Total terrorism					
	Internet			Mobile			Internet			Mobile		
Internet	0.00761*** (5.90e-05)	0.00759*** (2.50e-05)	0.00789*** (0.00202)				0.0114*** (0.00387)	0.0129*** (0.00139)	0.0207*** (0.00158)			
Mobile				0.000434*** (1.39e-05)	0.000752*** (5.28e-05)	0.000391** (0.000170)				0.00220*** (0.000594)	0.00264** (0.00118)	0.00549*** (0.000995)
Polity2		-0.00286*** (0.000395)	-0.0401*** (0.0146)									
Politicalstability												
Remittances												
Foreignaid												
L.Dependent												
Constant												
Observations	676	675	412	682	681	414	676	675	412	682	681	414
Countries	49	49	43	49	49	43	49	49	43	49	49	43
AR(1)	0.0377	0.0360	0.0344	0.0254	0.00710	0.0112	1.35e-05	2.29e-05	0.000714	9.43e-06	2.07e-05	0.000347
AR(2)	0.662	0.673	0.925	0.852	0.229	0.431	0.231	0.381	0.605	0.307	0.275	0.271
Instruments	22	32	30	20	26	30	17	33	35	22	26	30
Hansen OIR	0.360	03117	0.621	0.209	0.350	0.749	0.567	0.400	0.284	0.418	0.335	0.421

Fisher	9473***	374722***	88.91***	518.2***	1253***	123.7***	80.13***	199.8***	614.0***	780.2***	80.89***	132.0***
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Note:\*\*\*,\*\*,\*: Significance levels at 1%, 5% and 10% respectively. Standard errors reported in parenthesis. The significance of bold values is twofold. 1) The significance of estimated coefficients and Wald statistics. 2) The failure to reject the null hypothesis of: a) no autocorrelation in the AR (2) tests and; b) the validity of the instruments in the Hansen OIR tests.

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Table 6: ICT and terrorism with more control variables

VARIABLES	Dependent variable : Terrorism							
	Internet				Mobile			
	Domter	Transter	Unter	Totter	Domter	Transter	Unter	Totter
Internet	0.00698*** (0.00168)	0.00305*** (0.00102)	0.00287*** (0.000708)	0.00794*** (0.00217)				
Mobile					0.00385*** (0.000386)	0.00470*** (0.000845)	0.00119*** (0.000351)	0.00154*** (0.000226)
Polity2	-0.0399*** (0.00481)	-0.0334*** (0.00515)	-0.0658*** (0.00547)	<b>-0.0114</b> <b>(0.00735)</b>	-0.00881* (0.00496)	-0.0880*** (0.0149)	-0.0353*** (0.00392)	<b>-0.00471</b> <b>(0.00553)</b>
Politicalstab	-0.535*** (0.0209)	-0.412*** (0.0240)	-0.000778 (0.0422)	-0.792*** (0.0500)	-0.355*** (0.0446)	-0.336*** (0.0515)	0.158*** (0.0305)	-0.631*** (0.00801)
Remittances	0.0677*** (0.00444)	<b>0.000947</b> <b>(0.00133)</b>	0.0256*** (0.00365)	0.0122*** (0.00165)	0.00772** (0.00294)	0.0672*** (0.0226)	0.0164*** (0.00501)	0.00921** (0.00420)
ODA	<b>-0.00174</b> <b>(0.00815)</b>	<b>-0.00197</b> <b>(0.00206)</b>	<b>-0.00320</b> <b>(0.00453)</b>	<b>-0.00351</b> <b>(0.00439)</b>	<b>-0.00115</b> <b>(0.00186)</b>	-0.00114* (0.00566)	<b>-0.00237</b> <b>(0.00347)</b>	<b>-0.00308</b> <b>(0.00389)</b>
Education	-0.00982*** (0.00255)	0.00464*** (0.00135)	-0.00579*** (0.000597)	-0.0183*** (0.00177)	-0.0147*** (0.00111)	<b>-0.000366</b> <b>(0.00247)</b>	-0.0114*** (0.000932)	0.0147*** (0.000747)
FDI	-0.0246*** (0.00901)	0.00337** (0.00146)	-0.0462*** (0.00511)	-0.0103** (0.00409)	-0.00363** (0.00140)	<b>-0.00923</b> <b>(0.0105)</b>	-0.0223*** (0.00361)	-0.00283* (0.00151)
L.Dependent	0.232*** (0.0156)	0.260*** (0.0141)	0.0834*** (0.0190)	0.185*** (0.0234)	0.472*** (0.0231)	0.235*** (0.0252)	-0.106*** (0.00758)	0.398*** (0.00793)
Constant	0.690*** (0.117)	-0.0860 (0.0561)	0.857*** (0.0545)	-0.412*** (0.109)	-0.450*** (0.0670)	-0.0985 (0.158)	1.064*** (0.0868)	-0.528*** (0.0720)
Observations	<b>291</b>	<b>291</b>	<b>291</b>	<b>291</b>	<b>294</b>	<b>294</b>	<b>294</b>	<b>294</b>
Countries	<b>41</b>	<b>41</b>	<b>41</b>	<b>41</b>	<b>41</b>	<b>41</b>	<b>41</b>	<b>41</b>
AR(1)	<b>0.0117</b>	<b>0.0278</b>	<b>0.0309</b>	<b>0.00539</b>	<b>0.00708</b>	<b>0.0285</b>	<b>0.0240</b>	<b>0.00354</b>
AR(2)	0.327	0.480	0.686	0.427	0.155	0.524	0.598	0.587
Instruments	<b>32</b>	<b>34</b>	<b>32</b>	<b>32</b>	<b>34</b>	<b>34</b>	<b>32</b>	<b>33</b>
Hansen OIR	0.483	0.944	0.668	0.658	0.977	0.442	0.902	0.922
Fisher	2977***	7869***	18701***	905768***	80421***	876.7***	6450***	4623***

Note:\*\*\*, \*\*, \*: Significance levels at 1%, 5% and 10% respectively. Standard errors reported in parenthesis. The significance of bold values is twofold. 1) The significance of estimated coefficients and Wald statistics. 2) The failure to reject the null hypothesis of: a) no autocorrelation in the AR (2) tests and; b) the validity of the instruments in the Hansen OIR tests.

## 5. CONCLUSION,POLICY IMPLICATIONS AND FURTHER RESEARCH DIRECTIONS

This study has investigated the effect of information and communication technology (ICT) on terrorism in 49 African countries for the period

1998-2012. Two ICT indicators are used, they are: internet penetration and Mobile phone penetration. Four terrorism indicators are employed, they comprise: domestic, transnational, unclear, and total terrorism. The empirical evidence is based on the Generalized

Method of Moments. The main findings of this study is that ICT is found to have a positive and significant effect on terrorism. Additionally, while variables such as democracy, political stability, education and foreign direct investment reduce terrorism, remittances is positively associated with terrorism. The effect of foreign aid on terrorism is insignificant.

Based on the principal result of this study, the following policy implications must be pursued in to reduce the effect of ICT on terrorism. The massive use of ICTs and especially the Internet by terrorist groups also gives African countries a great opportunity to increase their internet presence to counter terrorism. However, the effectiveness of counter terrorism on the internet will only be achieved through a high level of sharing of information collected on the identity, location and activities of terrorist groups. The sharing of information is easy and fast between countries belonging to the same zone, hence the need for African countries

to accentuate regional integration. Regional integration will therefore enable the countries concerned to pool their technological and financial efforts to develop sophisticated intelligence tools to prevent, detect, monitor and, above all, neutralize terrorist acts in the region.

Although the results obtained indicate that this article corresponds to the theoretical foundations, one could capitalize on the small amplitude of the estimated coefficients and thus be interested in the evaluation of the transmission channels. Further studies can improve the existing literature by studying the effectiveness of the different channels through which the positive effect of ICTs on terrorism can be mitigated or cancelled. Potential channels could include, *inter alia* education, foreign aid, inclusive human development and greater regional integration in Africa.

## REFERENCES

1. RuchitaBeri 2017. Rise of Terrorism in Africa. Institute of Defense Studies and Analyses: IDSA.
2. Fazel, A., 2013. The growing terrorism threat in Africa. Mail & Guardian, <https://mg.co.za/article/2013-12-17-the-growing-terrorism-threat-in-africa> (Accessed :18/01/2019)
3. Alfa-Wali, M., Sritharan, K., Mehes, M., Abdullah, F., Rasheed, S., 2015. Terrorism-related trauma in Africa, an increasing problem. Journal of epidemiology and global health. 5(2), 201-203.
4. Asongu, S. A., Nwachukwu, J. C., 2016. Revolution empirics: predicting the Arab Spring. Empirical Economics. 51(2), pp. 439-482.
5. ITU 2015. Report, International Telecommunication Union. Geneva, Switzerland.
6. UNODC 2012. The use of the Internet for terrorist purposes. United Nations. New York. Available at: [https://www.unodc.org/.../Use\\_of\\_Internet\\_f\\_or\\_Terrorist\\_Purposes](https://www.unodc.org/.../Use_of_Internet_f_or_Terrorist_Purposes)
7. Wiener, N., 1948. Cybernetics or Control and Communication in the Animal and the Machine. Technology Press.
8. Shannon, C. E., 1948. A mathematical theory of communication. Bell system technical journal. 27(3), 379-423.
9. Zhang, Y., Li, X., Qiao, S., Zhou, Y., Shen, Z., 2018. Information Communication Technology (ICT) use among PLHIV in China: A promising but underutilized venue for HIV prevention and care. International Journal of Information Management. 38(1), 27-33.
10. Rubagiza, J., Were, E., Sutherland, R., 2011. Introducing ICT into schools in Rwanda: Educational challenges and opportunities. International Journal of Educational Development. 31(1), 37-43.
11. Cunska, A., Savicka, I., 2012. Use of ICT teaching-learning methods make school math blossom. Procedia-Social and Behavioral Sciences. 69, 1481-1488.
12. Olló-López, A., Aramendía-Muneta, M. E., 2012. ICT impact on competitiveness, innovation and environment. Telematics and Informatics. 29(2), 204-210.
13. CHAVULA
14. Morán, A. J., Profaizer, P., Zapater, M. H., Valdavida, M. A., Bribián, I. Z., 2016. Information and Communications Technologies (ICTs) for energy efficiency in buildings: Review and analysis of results from EU pilot projects. Energy and buildings. 127, 128-137.
15. Carmody, P., 2013. A knowledge economy or an information society in Africa? Thintegration and the mobile phone revolution. Information Technology for Development. 19(1), 24-39.
16. James, J., 2014. Product use and welfare: The case of mobile phones in Africa. Telematics and Informatics. 31(3), 356-363.
17. Asongu, S. A., Le Roux, S., 2017a. Enhancing ICT for inclusive human development in Sub-Saharan Africa. Technological Forecasting and Social Change. 118, 44-54.

18. Niebel, T., 2018. ICT and economic growth—Comparing developing, emerging and developed countries. *World Development*. 104, 197-211.
19. Ishida, H., 2015. The effect of ICT development on economic growth and energy consumption in Japan. *Telematics and Informatics*. 32(1), 79-88.
20. Yousefi, A., 2011. The impact of information and communication technology on economic growth: evidence from developed and developing countries. *Economics of Innovation and New Technology*. 20(6), 581-596.
21. Pohjola, M., 2002. The new economy in growth and development. *Oxford Review of Economic Policy*. 18(3), 380-396.
22. Bhattacharjee, A., Shrivastava, U., 2018. The effects of ICT use and ICT Laws on corruption: A general deterrence theory perspective. *Government Information Quarterly*. 35(4), 703-712.
23. Ali, M. S. B., Gasmi, A., 2017. Does ICT Diffusion Matter for Corruption? An Economic Development Perspective. *Telematics and Informatics*. 34(8), 1445-1453.
24. Garcia-Murillo, M., 2013. Does a government web presence reduce perceptions of corruption? *Information Technology for Development*. 19(2), 151-175.
25. Charoensukmongkol, P., Moqbel, M., 2014. Does investment in ICT curb or create more corruption? A cross-country analysis. *Public Organization Review*. 14(1), 51-63.
26. Higón, D. A., Gholami, R., Shirazi, F., 2017. ICT and environmental sustainability: A global perspective. *Telematics and Informatics*. 34(4), 85-95.
27. Jefferson, T., 2007. The use of ICTs in regional conflicts, war, and terrorism. *Vine*. 37(1), 14-17.
28. Hoffman, B., 2006. The use of the Internet by Islamic extremists, Testimony presented to the House Permanent Select Committee on Intelligence, May 4, 2006, Rand Corporation, CT-262-1, available at: <https://www.rand.org/pubs/testimonies/CT262-1.html> (accessed 28/12/ 2018).
29. Keene, S. D., 2011. Terrorism and the internet: a double-edged sword. *Journal of Money Laundering Control*. 14(4), 359-370.
30. Anderson, A. G., 2003. Risk, terrorism, and the Internet. *Knowledge, Technology & Policy*. 16(2), 24-33.
31. Lachow, I., Richardson, C., 2007. Terrorist use of the Internet: The real story. NATIONAL DEFENSE UNIV WASHINGTON DC.
32. Weimann, G., 2006. Virtual disputes: The use of the Internet for terrorist debates. *Studies in conflict & terrorism*. 29(7), 623-639.
33. Enders, W., Sandler, T., Gaibullov, K., 2011. Domestic versus transnational terrorism: Data, decomposition, and dynamics. *Journal of Peace Research*. 48(3), 319-337.
34. Gaibullov, K., Sandler, T., Santifort, C., 2012. Assessing the evolving threat of terrorism. *Global Policy*. 3(2), 135-144.
35. Marshall, M. G., Gurr, T. R., Jagers, K., 2013. Polity IV project: Political regime characteristics and transitions. 1800-2012. Center for Systemic Peace.
36. Efobi, U., Asongu, S., 2015. Foreign Direct Investment, Aid and Terrorism: Empirical Insight Conditioned on Corruption Control, African Governance and Development Institute Working Paper No. 15/007. Yaoundé.
37. Asongu, S. A., Nwachukwu, J. C., 2017b. The impact of terrorism on governance in African countries. *World Development*. 99, 253-270.
38. ALI AND GASMI (2017)
39. Haftu, G. G., 2018. Information communications technology and economic growth in Sub-Saharan Africa: A panel data approach. *Telecommunications Policy*.
40. Berrebi, C., 2007. Evidence about the link between education, poverty and terrorism among Palestinians. *Peace economics, peace science and public policy*. 13(1).
41. Azam, J. P., Thelen, V., 2008. The roles of foreign aid and education in the war on terror. *Public Choice*. 135(3-4), 375-397.
42. Tavares, J., 2004. The open society assesses its enemies: shocks, disasters and terrorist attacks. *Journal of monetary economics*. 51(5), 1039-1070.
43. Rehman, F. U., Vanin, P., 2017. Terrorism risk and democratic preferences in Pakistan. *Journal of Development Economics*. 124, 95-106.
44. Eubank, W. L., Weinberg, L., 1994. Does democracy encourage terrorism? *Terrorism and Political Violence*. 6(4), 417-435.
45. Elu, J. U., Price, G. N., 2012. Remittances and the Financing of Terrorism in Sub-Saharan Africa: 1974-2006. *Peace Economics, Peace Science and Public Policy*, 18(1).
46. Mascarenhas, R., Sandler, T., 2014. Remittances and terrorism: A global analysis. *Defence and Peace Economics*. 25(4), 331-347.
47. Asongu, S. A., Biekpe, N., 2018. Globalization and terror in Africa. *International economics*. 156, 86-97.
48. Azam, J. P., Delacroix, A., 2006. Aid and the delegated fight against terrorism. *Review of Development Economics*. 10(2), 330-344.
49. Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*. 58(2), 277-297.
50. Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of

- error-components models. *Journal of econometrics*. 68(1), 29-51.
51. Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*. 87(1), 115-143.
  52. Roodman, D., 2009b. A note on the theme of too many instruments. *Oxford Bulletin of Economics and statistics*. 71(1), 135-158.
  53. Roodman, D., 2009a. How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*. 9(1), 86-136.
  54. Lewis, J., 2005. *Language wars: The role of media and culture in global terror and political violence*. Pluto Press.
  55. Jetter, M., 2017. The effect of media attention on terrorism. *Journal of Public Economics*. 153, 32-48.
  56. Nasir, M., Rehman, F. U., Orakzai, M., 2012. Exploring the nexus: Foreign aid, war on terror, and conflict in Pakistan. *Economic Modelling*. 29(4), 1137-1145.

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