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Tourism, ICT and inclusive development: global evidence

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Abstract

This study empirically examines the effect of tourism and ICT on inclusive development. Inclusive development is approached as human development adjusted for environmental sustainability; ICT is based on mobile phones subscription rate, internet penetration and fixed broadband subscription and a composite indicator of these, while tourism is approached as the number of arrivals. The data are collected for 142 countries globally between the 2000-2019 period and the regression methodologies involve the POLS, the Driscoll and Kraay estimator, the Mean Group, the System GMM and the fixed effects Tobit regression. The results of the linear model show that, tourism enhances sustainable development and ICT has a negative significant effect. While the effect of tourism is robust across income groups, regional groupings and regression methodologies, the effect of ICT varies across these different specifications. When non-linearity is considered, the effects of both ICT and tourism are positive and robustly non-linear. The non-linear effect of tourism is not however feasible across income groups. Besides, while the effect of tourism is positively and non-lineally related to sustainable development in politically-stable economies, the effect is non-significant in unstable economies. From the results, countries should seize the opportunity offered by the tourism sector and ICT as effective policy tools towards sustainable development. In this regard, countries should invest in both ICT and tourism while observing the thresholds where complementary policies should be used. Also, politically-unstable economies should engage in peace talks such that they could join their politically-stable counterparts in benefiting from the positive economic effects offered by tourism and ICT.

***Keywords*:** Inclusive development; ICT; tourism
***JEL Classification*:** G20; I10; I32; O40; Z32

1. Introduction

Inclusive development has increasingly become a buzzword in policy discuss around the globe today. This is especially true since the adoption of the sustainable development goals (SDGs) in 2015 with 17 objectives all aimed at meeting a development that involves every nation and every individual in the 2030 horizon. Despite this applauding initiative of the United Nations, economic development is still exclusive in most parts of the World today. There is therefore the need for more elaborate policies in meeting this deadline. In fact, Nchofoung and Asongu (2022 a) recently established disparities in meeting this agenda and that one of the reasons behind these disparities is the level development of ICT of each economy. At the same time, Adeola and Evans (2020) argue that increase in ICT infrastructures boosts tourist arrivals while tourism has been established as a key determinant for inclusive development (Vázquez et al., 2018). The objective of this paper is therefore to establish the effects of tourism and ICT on inclusive development.

The United Nations World Tourism Organization (UNWTO) estimates that internationally, there were just 25 million tourist arrivals in 1950, a number that rose to 1.4 billion international arrivals per year by 2018. In this progress, developing regions like Africa moved from 500 thousand tourist arrivals in 1950 to 67 million in 2018. Asia and pacific witnessed a jump from 200thousand in 1950 to 243 million arrivals in 2018. This shows that these two developing regions witnessed relative changes of 13300% and 171400% respectively in 68 years. At the same time, developed regions like Europe only witnessed an increase of 4144% within the same 68 years period. This growth in the tourism sector demonstrates the importance of tourism to the developing economies compared to the developed world. In this respect, Kim et al. (2016) argue that tourism leads to poverty reduction and economic development in while Gnangnon (2020) posits that tourism increases development through its ability in enhancing public revenue. Also, tourism affects development by increasing income inequality within the economy (Alam and Paramati, 2016; Fang et al., 2021). It enhances environmental quality through increased economic growth, though this is only evident at a later stage of development (Balsalobre-Lorente et al., 2020; Paramati et al., 2017).

On the other hand, while tourism has been growing more in developing economies than in developed economies, the trend of ICT seems to have followed the reverse trend, whereas tourism development is promoted by an increase in the digitalization of the economy (Adeola and Evans, 2020; Choudhary et al., 2020). In essence, by the year 1990, most economies especially developing economies were not connected to the internet and by 2021, 63% of the World's population had access to the internet up from 16.8% in 2005, though disparities are evident in developed and developing economies. In quintessence, while 90% of the population had access to the internet in developed economies in 2021, up from 52.8% in 2005, only 57% of the population had access in developing countries by 2021, up from 8.1% in 2005. This further demonstrates the importance of digitalization for economic

development. In fact, Nchofoung and Asongu (2022 a) recently argue that ICT is the core for these countries in achieving inclusive development.

Despite the demonstrated importance of ICT and tourism for the economic development, the development of these economies is not following the same trend of growth, though there are few exceptions like China. Since the adoption of the SDGs in 2015, the global average of the sustainable development scored had been consistently increasing except in 2019 when it started witnessing a drop that further went down to 2020. This corresponds to a period when global tourism went into recession as a result of the Covid-19 pandemic. Unfortunate no study to the best of knowledge has examined the effect of tourism on inclusive development through the sustainable development scores approach.

The contribution of this study to literature is therefore at least threefold. First this is the first study to examine the simultaneous effect of tourism and ICT on inclusive development. Past studies have focused on the effect of ICT (Nchofoung and Asongu, 2022 a), while that of tourism has been neglected. This study therefore considers both tourism and ICT. Secondly, this study approaches sustainable development through the sustainable development index which is human development adjusted for environmental quality. Past studies on inclusive development have approached the subject through human development adjusted for inequality (Asongu and Boateng, 2018; Asongu and Nwachukwu, 2017a, 2017b; Asongu et al., 2017; Asongu and Le Roux, 2017; Nchofoung et al., 2021; Nchofoung et al., 2022 a). This study therefore uses human development adjusted for environmental sustainability, which is in line with the definition of Gupta et al. (2015) who define inclusive development as development that involves all groups without compromising for the environmental needs of the future generations. Third, the study controls for regional groupings, political stability and income levels. This is particularly important given that Nchofoung et al. (2021) argue that these heterogeneities are at the origin of disparities in inclusive development. Besides, a politically-stable environment would attract tourists than a politically-unstable environment. Fourth, the modelling takes into account non-linearity. This is specifically because, Biagi et al. (2017) established that the effect of tourism on social development is non-linear, presenting a negative relationship in small developed countries, suggesting that above a certain threshold of tourism development, certain negative externalities are produced in the economy. The study will therefore help policy makers in strategizing on the sustainable development deadline through the exploration of the tourism and ICT sectors.

The remainder of the paper is structured around a literature review (section 2), data and econometric strategy (section 3), empirical results and discussions (section 4) and results and policy implications (section 5).

2. Literature review

The literature starts with a theoretical underpinning followed by an empirical literature that is divided into two strands.

2.1. Theoretical underpinning

The theoretical underpinnings surrounding the nexus between ICT, tourism and inclusive development outcomes can be discussed in two main strands, notably: (i) the linkages between ICT and inclusive development and (ii) the connection between tourism and inclusive development. The two strands are expanded in the same chronology as highlighted.

First, on the linkage between information technology and inclusive development, in the Neoclassical growth theory, sustainable development has been approached as "sustainable growth". In this theory, technology is a deterministic factor of economic development though its deterministic implication is exogenous. In essence, technology change could affect economic development through its direct implication on the labour market or its implications in augmenting both labour and capital as factors of production in an economy. In their sustainable growth model, there is a possibility of substitution between human and physical capital (Kamien and Schwarz, 1982). Also, the endogenous growth theory focuses on their part on the contribution of technological innovation to the conditions under which economic growth can be sustained by resources and the environment (Howitt and Aghion, 1998; Bovenberg and Smulders, 1995). This strand of underpinnings is consistent with Asongu and le Roux (2017) on the linkage between ICT and inclusive development outcomes.

Second, the theoretical connection between tourism and inclusive development is consistent with Folarin and Adeniyi. (2020) and Odhiambo (2021) on the linkages between tourism and outcomes of poverty alleviation and income inequality mitigation. According to the attendant literature, tourism is a considered as an origin of inclusive development, not least, because it provides opportunities for employment generation which by extension, contributes towards reducing income inequality and poverty as well as boosting economic prosperity (Simm, 2005). Moreover, consistent with the underlying literature, a number of mechanisms by which tourism development contributes towards inclusive development have been documented (McCulloch et al., 2001; Blake et al., 2008; Njoya and Seetaram, 2018). The income mechanism for instance, permits households to gain revenue from activities related to tourism. The tax mechanism also maintains that households can gain, owing to better allocation of resources by the government especially as it pertains to allocating resources to the promotion of the result that would ultimately engender inclusive development avenues in terms of poverty alleviation and inequality mitigation.

2.2. Empirical evidence

There are two main strands of literature that follow here. First, the effect of ICT on economic development is presented before the effect of tourism on economic development follows.

In the first strand of debate, several authors examine the effect of ICT on economic development by approaching development through the human development index adjusted for inequality (Asongu and Nwachukwu, 2016, 2017 a, 2018; Asongu and Le Roux, 2017; Asongu et al., 2017; Asongu et al., 2019; Asongu and Odhiambo, 2019a; Adegboye, 2021; Asongu, 2021; Nchofoung et al., 2022). In this line of study, some of these authors argue that ICT enhances inclusive human development. In this respect, Asongu and Le Roux (2017) argue that the positive relationship varies per income group and ICT specifications used. Also, poor primary education has been established to dampen the positive effect of ICT on inclusive human development (Asongu and Odhiambo, 2019 a), a view corroborated by the study of Asongu (2021). Nchofoung et al. (2022) rather argue that though investments in infrastructures enhances inclusive human development, that is not the case with ICT infrastructure as ICT infrastructure rather harm inclusive human development due to its ability to increase income inequality. ICT can however, be use as a policy tool in dampening the negative effect that CO2 exert on inclusive human development (Asongu et al., 2017).

Also, approaching sustainable development through the human development index adjusted for environmental sustainability, Nchofoung and Asongu (2022) posit that ICT enhances sustainable development and that the relationship is contingent on the choice of the ICT indicator used, the geographical region of the economy and the income group to which it belongs. Besides, globalization thresholds for the established relationship to be feasible were provided by authors. Recently, Asongu and Odhiambo (2022) as an introduction to a special issue on information technology on sustainability stress on the importance of information technology being it through usage, in relationship with economic growth or its ability to reduce poverty as a necessary tool in the sustainable development discuss. Away from these composite indicators, ICT has been found important for environmental sustainability (Higónet al., 2017; Avom et al, 2020; N'dri et al., 2021; Adebayo et al., 2020). Also, some authors study the sustainable development concept through educational quality and argue that ICT enhances the quality of education (Livingstone, 2012; Asongu and Odhiambo, 2019 b). Moreover, sustainable development has been materialized through the health outcome of ICT, arguing that ICT is necessary for improved health in both developed and developing economies (Dutta et al., 2019; Majeed and Khan, 2019; Ronaghi, 2022).

The second strand of literature examines the effect of tourism on economic development. In this regard, the first group of authors examine the effect of tourism on social development (Biagi et al., 2017; Croes et al., 2020; Folarin and Adeniyi, 2020; Ofori et al., 2021). The authors argue that tourism enhances human development through increase in literacy rate and educational quality though the effect is always affected by several factors. In fact, the

effect of tourism on social development is non-linear, presenting a negative relationship in some developed countries, suggesting that above a certain threshold of tourism development, certain negative externalities are produced in the economy (Biagi et al., 2017). Besides, tourism reduces poverty especially when it is accompanied by equitable poverty distribution (Folarin and Adeniyi, 2020).

Another group of research focuses on the effect of tourism on environmental sustainability (Azam et al., 2018; Lee and Brahmasrene, 2016; Paramati et al., 2017; Paramati et al., 2018; Ali et al., 2021; El Menyari, 2021; Liu et al., 2022; Usman et al., 2021). In accordance with these studies, sustainable development should be ensured by implementing prudent public policy where host governments must strive to promote socially and environmentally responsible tourism industries in their respective countries. The effect of tourism on environmental quality however varies from region to region. While tourism plays an important role in the heightening of economic growth, its role on environmental sustainability largely depends on the adaptation of sustainable tourism policies and efficient management put in place (Paramati et al., 2018). Nevertheless, in oil-producing countries, unlike in non-oil producing countries, environmental degradation is highly explained by energy use and economic growth and not by tourism (Lee and Brahmasrene, 2016). Therefore, host nations should not only encourage tourism, but also guarantee that the environmental quality is sustained. In this regard environmentally friendly tourism policies should be established to maintain a positive path towards sustainable development (Ali et al., 2021).

The last and not the least group of authors argue on the importance of tourism on economic development. In this line of research, some authors argue that tourism enhances economic growth (Fayissaet al., 2008; Nissan et al., 2011; Nunkoo et al., 2020; Nyasha et al., 2021; Rasool et al., 2021; Wu et al., 2022). According to these authors, international tourism would augment economic growth through its ability to enhance foreign exchange reserve, as a result, stimulates investments in infrastructures and human capital, leading to economic competitiveness. Moreover, international tourism leads to positive externalities in the host economies, creating more jobs and enhancing industrial development (Rasool et al., 2021).

3. Data and econometric strategy

3.1. Data and preliminary statistics

The data are collected for 142 countries between the 2000-2019 periods. The choice of the study period and the sampled countries are based on the availability of data on the variables under consideration. The data sources include: the World Development Indicators (WDI) of the World Bank and Hickel (2020).

Dependent variable

The dependent variable is inclusive development proxied by the sustainable development index of Hickel (2020), which captures the human development of nations adjusted for environmental sustainability. The human development is computed as the geometric mean between life expectancy, education and modified income indexes. The environmental dimension is measured through the ecological impact index (EII) and measures the extent to which material footprints and CO2 emission that is consumption based exceed the per capita planetary boundaries of the earth. This methodology for calculating this index is detailed in Hickel (2020) and has been recently used by Nchofoung and Asongu (2022a).

Independent variable of interest

The first independent variable of interest used in this study is Tourism proxied by the number of tourist arrivals. This has been used in recent studies including Nyasha et al. (2021) and Oforiet al. (2022). Nyasha et al. (2021) argue that tourism arrivals enhance economic development. This variable is thus expected to produce a positive sign. The next independent variable is ICT proxy the average between mobile phones subscription rate, internet penetration and fixed broadband subscription. Such a composite indicator for ICT has been recently used by Kouladoum et al. (2022). Nchofoung and Asongu (2022 a) argue of a pessimistic effect of ICT on sustainable development. This variable is therefore expected to produce a negative sign. Figure 1 presents the fitted plot of the perceived relationship.

Figure 1. Fitted scatter plot on the effect of ICT and tourism on inclusive development

Source: Authors' computation

Figure 1 shows that ICT has a perceived negative relationship with inclusive development while that of tourism though seemingly negative appears to be non-significant. The actual effect is only however established in a regression that considers other control variables in the economy.

Control variables

The first control variable is foreign direct investment inflows and is expected to produce a positive relationship in accordance with Immurana (2021) who argue that FDI inflows enhance sustainable development through its positive effect on life expectancy. The next control variable is financial development and is expected to produce either a positive or negative sign in accordance with Asongu and Nting (2021) who argue that financial development can have a positive or negative effect on inclusive human development depending on the proxy of financial development used. Equally, resource rent is used in accordance with Nchofoung et al. (2021) and is expected to present a positive sign following this study. Trade openness is the next control variables and is expected to produce a positive effect with respect to Nchofoung (2022). The last but not the least control variable is economic growth and should enhance sustainable development in line with Nchofoung and Asongu (2022 a). Tables 1 and 2 present the summary statistics and the correlation matrix, respectively.

Table 1. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Sustainable development index	2810	.568	.171	.079	.853
Tourism arrivals (log)	2578	14.632	1.883	7.972	19.172
fixed broadband	2358	9.01	11.791	0	46.82
Internet	2718	31.748	30.039	0	99.701
mobile subscription	2812	74.948	48.908	0	212.639
ICT	2270	44.131	25.948	.059	112.786
Foreign direct investment	2797	5.567	18.042	-40.33	449.083
Financial development	2437	52.301	46.282	.186	304.575
Resource rents	2814	7.396	10.827	0	67.918
Trade openness	2715	83.291	47.347	.167	437.327
GDP per capita	2812	8.47	1.52	5.272	11.431

Table 2. Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Sustainable development index	1.000										
(2) tourism	-0.106	1.000									
(3) fixed broadband	-0.482	0.479	1.000								
(4) Internet	-0.395	0.516	0.875	1.000							
(5) mobile subscription	-0.084	0.373	0.556	0.712	1.000						
(6) ICT	-0.279	0.485	0.811	0.925	0.920	1.000					
(7) foreign direct investment	-0.088	-0.017	0.108	0.081	0.062	0.083	1.000				
(8) financial development	-0.428	0.512	0.402	0.427	0.384	0.554	0.193	1.000			
(9) resource rents	0.088	-0.261	-0.289	-0.242	-0.099	-0.196	-0.058	-0.316	1.000		
(10) trade openness	-0.200	0.084	0.265	0.271	0.270	0.298	0.290	0.187	-0.096	1.000	
(11) GDP per capita	-0.414	0.627	0.444	0.400	0.518	0.719	0.099	0.576	-0.208	0.257	1.000

Table 1 shows that on average, our sample countries are above 50% in realising the SDGs. In fact, some countries have performed as high as 85%. Equally, while some countries have very good performance in ICT mostly attributed to high scores in the internet penetration rate and mobile phone subscription, the fixed broadband subscription is still wanting in a lot of these countries. Equally, Table 2 shows that the coefficients of correlation between our variables of interest are very low indicating that the variables can be used in the same model.

3.2. Model specification and regression methodology

Based on attendant literature on the subject (Nchofoung and Asongu, 2022 a), the following empirical models can be specified.

$$SDI_{it} = \beta_0 + \beta_1 Toursim_{it} + \beta_2 ICT_{it} + \beta_j X_{it} + \upsilon_i + \gamma_t + \varepsilon_{it} \quad (1)$$

Where SDI is the sustainable development index which is used as a proxy for inclusive development, Tourism is the number of tourism arrivals, ICT is information and communication technology, X is the vector of control variables at time, t and country, i. j is the number of coefficients associated with control variables. υ is the country specific effect, γ is the time fixed effect and ε is the stochastic error term.

The correlation of the first period lagged dependent variable and the dependent variable gives a correlation coefficient of 0.9941. This puts into evidence the importance of initial economic conditions in our model. (1) It is thus further specified taking into account this condition.

$$SDI_{it} = \beta_0 + \beta_1 SDI_{i(t-1)} + \beta_2 Toursim_{it} + \beta_3 ICT_{it} + \beta_j X_{it} + \upsilon_i + \gamma_t + \varepsilon_{it} \quad (2)$$

In other to estimate (2), the presence of the lagged dependent variable in is likely to correlate with specific country effects, generating an endogeneity bias (Nickell, 1981). The system Generalised Method of Moments (GMM) has been identified as an efficient estimator. The estimator controls for unobserved heterogeneity that may arise in the regression procedure, corrects for possible endogeneity resulting from bidirectional causality and equally controls for cross-sectional dependence between panels. This methodology is feasible for this study because our data satisfies the preliminary conditions for the use of GMM to be implemented as documented in attendant literature on the subject (Tchamyou, 2020; Tchamyou, 2021; Nchofoung et al., 2022 a; Nchofoung and Asongu, 2022 a, b). These conditions include, the number of cross-sections (117) which is greater than the number of periods (20) in accordance to Roodman (2009) for the implementation of the GMM as a regressor. The GMM specification can therefore be specified at level and first difference as in (3) and (4), respectively.

$$SDI_{it} = \beta_0 + \beta_1 SDI_{i(t-\tau)} + \beta_2 Tourism_{it} + \beta_3 ICT_{it} + \sum_{h=1}^{k} \delta_h X_{h,i(t-\tau)} + \upsilon_i + \gamma_t + \varepsilon_{it} \quad (3)$$

$$SDI_{it} - SDI_{i(t-\tau)} = \beta_1 \left(SDI_{i(t-\tau)} - SDI_{i(t-2\tau)}\right) + \beta_2 \left(Tourism_{it} - Tourism_{i(t-\tau)}\right) + \beta_3 \left(ICT_{it} - ICT_{i(t-\tau)}\right) + \sum_{h=1}^{k} \delta_h \left(X_{h,i(t-\tau)} - X_{h,i(t-2\tau)}\right) \left(\gamma_t - \gamma_{t-\tau}\right) + \varepsilon_{i(t-\tau)} \quad (4)$$

Where the variables are as defined above.

Several problems are always encountered when dealing with the GMM framework. These are the problem of (i) identification (ii) simultaneity and (iii) exclusion restrictions. To resolve these problems, all our explanatory variables are suspected to be endogenous and treated as such in accordance with extant literature on the GMM methodology (Tchamyou, 2020; Tchamyou, 2021; Nchofoung et al., 2022 a; Nchofoung and Asongu, 2022a, 2022b). Besides, given that the period dummies included as explanatory variables in our model are strictly exogenous, these dummies were used as instruments. Roodman (2009) as an extension of the Arellano and Bover (1995) adopted the forward orthogonal deviation to limit instruments' proliferation and maximize sample size. We adopt the said forward orthogonal deviation methodology in this study to limit instrument proliferations.

Equally, given that our dependent variable (SDI) has a limited range (can only vary between 0 and 1), the Tobit regression methodology is applied to take care of the limited range in the dependent variable. Our data for the SDI varies between 0.079 and 0.853 as apparent in Table 1. Estimating the model with a doubled censored Tobit is thus similar to estimating through a linear regression because the likelihood functions coincide (Asongu and le Roux, 2017; Nchofoung et al., 2021; Nchofoung and Asongu, 2022 a).

The simple Tobit model is specified therefore thus:

$$SDI^*_{it} = \alpha_0 + \beta X_{it} + \mu_{it} \quad (5)$$

Where SDI* is the latent response variable to the vectors of exogenous variables, X. α_0 is the constant term, and μ is independent and identically distributed (iid). The random error term influences the observations of the latent response variable as in (6).

$$SDI_{it} = \begin{cases} SDI^*_{it} \; if \; SDI^*_{it} > \varepsilon \\ 0 \; if \; SDI^*_{it} \leq \varepsilon \end{cases} \quad (6)$$

Also, equation (1) can be specified considering a possibility of non-linear effects on both tourism and ICT. In this case (7) is obtained.

$$SDI_{it} = \beta_0 + \beta_1 Toursim_{it} + \beta_2 Tourism^2_{it} + \beta_3 ICT_{it} + \beta_4 ICT^2_{it} + \beta_j X_{it} + \upsilon_i + \gamma_t + \varepsilon_{it} \quad (7)$$

Where the variables are as defined above. Taking the first partial derivative of (7) yields.

$$\begin{cases} \dfrac{\partial SDI_{it}}{Toursim_{it}} = \beta_1 + 2\beta_2 Toursim_{it} \\ \dfrac{\partial SDI_{it}}{ICT_{it}} = \beta_3 + 2\beta_4 ICT_{it} \end{cases} \quad (8)$$

Equating each partial derivative to zero and looking for both thresholds of ICT and tourism for a non-linear relationship to be feasible, we obtain.

$$\begin{aligned} Toursim_{threshold} &= \frac{\beta_1}{2\beta_2} \\ ICT_{threshold} &= \frac{\beta_3}{2\beta_4} \end{aligned} \quad (9)$$

The thresholds are always positive because for it to be feasible, the signs of the variables in the linear state and that in the non-linear state must be opposing. As a result, cancelling out the negative signs in β_1 and β_3 that should have occurred in (9).

4. Empirical results and discussions

4.1. Baseline regression

The analysis begins with a baseline specification methodology through the Driscoll and Kraay (1998) standard error, the Mean Group and the Pooled Ordinary Least Squares (POLS) methodologies. Table 3 presents the results of these estimators.

Table 3. Baseline estimation

	(1)	(2)	(3)
	Driscoll/Kraay	MG	Pooled OLS
VARIABLES	Dependent variable: Sustainable development index		
Tourism	0.0159***	0.000500*	0.0291***
	(0.00473)	(0.0125)	(0.00273)
Information and communication technology	-0.000317	0.000172	0.000610***
	(0.000314)	(0.000253)	(0.000211)
Foreign direct investment	-0.000198***	0.000159	0.000350**
	(5.86e-05)	(0.000460)	(0.000178)
Financial development	-0.000173	-0.000244	-0.00128***
	(0.000205)	(0.000243)	(0.000109)
Resource rents	-1.89e-05	-2.846	-0.000424
	(0.000282)	(2.221)	(0.000453)
Trade openness	-7.92e-05	0.000187	-0.000330***
	(9.42e-05)	(0.000196)	(7.75e-05)
GDP per capita	-0.00561	-0.140***	-0.0493***
	(0.0169)	(0.0539)	(0.00435)
Constant	0.414**	2.244***	0.645***
	(0.183)	(0.507)	(0.0389)
Observations	1,758	1,605	1,758
R-squared			0.275
Fisher	11.46***		94.89***
chi2		10.20***	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 shows that tourism has a positive significant effect on inclusive development while the effect of ICT is apparently non-significant. Also, foreign direct investment has a negative significant effect on sustainability. However, before given economic interpretations to the obtained results, there is necessity to correct for possible endogeneity while taking into account initial economic conditions. Table 4 presents the results through the GMM methodology.

Table 4. System GMM results

VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: sustainable development index (SDI)			
L.SDI	0.882***	0.916***	0.900***	0.955***
	(0.0266)	(0.0219)	(0.0211)	(0.0243)
Tourism	0.0116**	0.00959**	0.0152***	0.00960**
	(0.00525)	(0.00454)	(0.00560)	(0.00480)
ICT	-0.000452***			
	(0.000168)			
Foreign direct investment	-0.000125***	-0.000113***	-0.000149***	-0.000102***
	(2.61e-05)	(2.45e-05)	(3.34e-05)	(2.21e-05)
Financial development	0.000338***	0.000253***	0.000362***	0.000233***
	(6.13e-05)	(7.24e-05)	(8.08e-05)	(6.35e-05)
Resource rents	0.000240	0.000284	0.000684***	0.000195
	(0.000312)	(0.000209)	(0.000248)	(0.000226)
Trade openness	0.000168	0.000102	4.35e-05	0.000163
	(0.000122)	(9.63e-05)	(0.000116)	(0.000100)
GDP per capita	0.00733	0.00535	-0.0123	-0.00235
	(0.0148)	(0.0118)	(0.0123)	(0.0121)
Mobile subscriptions		-0.000198***		
		(4.62e-05)		
Internet			-0.000357***	
			(9.37e-05)	
Fixed broadband subscriptions				0.000785***
				(0.000290)
Constant	-0.177	-0.141	-0.0698	-0.134
	(0.135)	(0.111)	(0.136)	(0.130)
Time fixed effect	Yes	Yes	Yes	yes
Observations	2,742	2,027	1,960	2,809
Number of countries	142	141	139	141
Prop>AR1	0.00132	0.000791	0.000838	0.00143
Prop>AR2	0.370	0.302	0.340	0.386
Instruments	51	51	43	51
Prop>Hansen	0.232	0.190	0.283	0.0703
Fisher	191.4***	205.6***	179.0***	364.4***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 shows that tourism enhances inclusive development while ICT has a negative significant effect. The negative effect of ICT corroborates the result of Nchofoung and Asongu (2022) while the positive effect of tourism is in line with the Nyasha et al. (2021) who argue that tourism arrivals enhance economic development. This enhancing effect of tourism can be explained by the fact that increase in tourism enhances economic growth and welfare (Nissan et al., 2011). In this respect, tourism provides enough funds required to finance domestic investments which subsequently lead to increase in economic productivity, creating new jobs, and as a result increase in the welfare of the population. Incursion of digital technologies on the other hand without the corresponding increase in human capital development will lead to unskilled labour layoff in industrial positions leading to a fall in the welfare of the population. This is particularly true for this study given that majority of the countries in the sample are developing economies and are characterized by unskilled labour in their labour force (Ngouhouo and Nchofoung, 2021).

The lagged dependent variable is positive and significant putting into evidence the importance of initial economic conditions in the sustainable development agenda (Bolt, 2010; Nchofoung et al., 2022 b). This shows that countries would benefit by keeping their sustainable development scores on an increasing trajectory as a fall in one period will lead to further fall in the next period. Also, financial development has an enhancing effect on inclusive development and corroborates the results of Asongu and Nting (2021). An increase in financial development would enable domestic firms to be more opened to financial services for domestic investments, leading to economic productivity and welfare. The counter intuitive result here is the negative effect of foreign direct investments. The sustainable development index is the human development index adjusted for environmental quality. Following the pollution haven hypothesis, firms would seek to invest in foreign countries where the environmental norms are more relax (Singhania and Saini, 2021), increasing pollution in the host economies leading to a deterioration of welfare.

4.2. Robustness and sensitivity checks

Given the limited range of our dependent variable (0-1), the Tobit regression is applied to verify the robustness of our results. Table 5 presents these results.

Table 5. Tobit regression results

	(1)	(3)	(5)	(7)
VARIABLES	Dependent variable: sustainable development index (SDI)			
Tourism	0.0291***	0.0307***	0.0352***	0.0278***
	(0.00273)	(0.00250)	(0.00255)	(0.00262)
ICT	-0.000617***			
	(0.000211)			
Foreign direct investment	0.000354**	0.000298*	0.000257	0.000274
	(0.000178)	(0.000177)	(0.000181)	(0.000173)
Financial development	-0.00128***	-0.00137***	-0.00117***	-0.00106***
	(0.000109)	(0.000104)	(0.000110)	(0.000106)
Resource rents	-0.000402	-0.000405	-0.000175	-0.00145***
	(0.000453)	(0.000392)	(0.000403)	(0.000442)
Trade openness	-0.000339***	-0.000294***	-0.000175**	-0.000193***
	(7.76e-05)	(7.43e-05)	(7.56e-05)	(7.42e-05)
GDP per capita	-0.0494***	-0.0430***	-0.0247***	-0.0182***
	(0.00435)	(0.00372)	(0.00444)	(0.00430)
Mobile subscriptions		0.000900		
		(8.85e-05)		
Internet			-0.000701***	
			(0.000194)	
Fixed broadband subscriptions				-0.00487***
				(0.000443)
Constant	0.646***	0.511***	0.361***	0.452***
	(0.0388)	(0.0323)	(0.0359)	(0.0386)
Observations	2,758	2,096	2,026	1,825
Lower censored limit	0.0790	0.0790	0.0790	0.0790
Upper censored limit	0.850	0.850	0.850	0.850

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The result of the Tobit regression shows that the positive effect of tourism and the negative effect of ICT persist with the Tobit regression methodology. Therefore, the results interpreted

above holds across different regression methodologies. Table 6 equally highlights the results across different regional groupings and income groups. In all, tourism enhances inclusive development across all these groups, except for Americas, Asia and upper–middle income countries with non-significant effects. The effect of ICT however varies from one region to another and from one income group to another. While the effect is negative in Africa, Americas and low and lower-middle income countries, the rest of the groups rather show an enhancing effect of ICT. This can be explained by the fact that Africa and America are the least developed continents in the World in terms of human capital and increase in ICT leads to lose of jobs by unskilled labour in these groups of countries and consequently decrease in welfare. Equally, these continents have majority of the countries in the low and lower-middle income categories which further explain the negative signs in these groups of countries.

Given this variation of results especially for ICT, there is necessity to verify if the actual relationship between ICT and tourism on inclusive development is non-linear. In this respect, the next section examines the possible non-linearity between the underlined variables.

Table 6. Results across different clusters

	(1)	(3)	(5)	(7)	(9)	(11)	(13)	(15)	(17)
	Africa	Europe	Americas	Asia	Oceania	Low-income countries	Lower-middle income countries	Upper-middle income countries	High income countries
VARIABLES	Dependent variable: sustainable development index								
Tourism	0.0231***	0.0292***	-0.00813	0.00644	-0.235***	0.0184	0.00423*	0.000750*	0.00334**
	(0.00350)	(0.00312)	(0.00506)	(0.00490)	(0.0324)	(0.00424)	(0.00237)	(0.00285)	(0.00356)
ICT	-0.00197**	0.00264***	-0.00147***	0.000164	0.00357***	-0.00255***	-0.00165***	0.000371*	0.00163***
	(0.000249)	(0.000283)	(0.000293)	(0.000334)	(0.000604)	(0.000313)	(4.44e-05)	(0.000192)	(0.000281)
Foreign direct investment	-0.00204**	0.000188	0.00397***	2.37e-05	-0.00195	-0.00224***	-0.000864	0.00403***	9.83e-05
	(0.000939)	(0.000197)	(0.00140)*	(0.000195)	(0.00145)	(0.000770)	(0.000764)	(0.000874)	(0.000147)
Financial development	0.000368**	-9.62e-05	-0.00293***	0.000186	-0.000620	0.000411	0.000651***	-0.000811***	-0.000472***
	(0.000171)	(0.000127)	(0.000176)	(0.000214)	(0.000544)	(0.000583)	(3.14e-05)	(0.000119)	(0.000127)
Resource rents	0.00356***	0.00243**	0.000810	0.00103*	-0.0110***	-0.000407	0.00169***	-0.000826*	-0.00133**
	(0.000511)	(0.00120)	(0.000836)	(0.000596)	(0.00289)	(0.000826)	(6.03e-05)	(0.000454)	(0.000542)
Trade openness	7.97e-05	0.000257*	0.000267	-0.000559***	-0.000877	0.000544*	0.000168***	-6.54e-05	-0.000514***
	(0.000162)	(0.000135)	(0.000236)	(8.81e-05)	(0.000641)	(0.000295)	(5.31e-05)	(0.000120)	(7.65e-05)
GDP per capita	0.0226***	-0.157***	0.00225	-0.0745***	-0.0732**	-0.0271***	0.0288***	-0.0386***	-0.178***
	(0.00611)	(0.00637)	(0.0102)	(0.00694)	(0.0339)	(0.00963)	(0.00927)	(0.00999)	(0.0106)
Constant	-0.0196	1.762***	0.828***	1.150***	4.598***	0.332***	0.269***	1.094***	2.437***
	(0.0433)	(0.0673)	(0.0864)	(0.0789)	(0.333)	(0.0653)	(0.0941)	(0.0816)	(0.116)
Observations	431	525	333	440	29	142	501	467	632
chi2	330.8***	733.5***	349.9***	263.5***	144.1***	96.24***	96.01***	115.8***	468.5***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3. Considering non-linear effect

Tables 7 and 8 present the results taking into account the possible non-linearity that could arise. While Table 7 considers the overall sample and continental clusters, Table 8 considers income groups and political stability. The level of political stability considered in this study follows the World Bank's classification.

Table 7. Non-liner effect considering regional groupings

	(1)	(3)	(5)	(7)	(9)	(11)
	Dependent variable: Sustainable development index					
VARIABLES	Overall	Africa	Europe	Americas	Asia	Oceania
Tourism	0.256***	0.187***	0.0412	0.437***	0.0894*	0.0530
	(0.0245)	(0.0369)	(0.0421)	(0.0618)	(0.0481)	(0.0507)
tourism_Squared	-0.00757***	-0.00605***	-0.000367	-0.0140***	-0.00275*	-0.00156
	(0.000802)	(0.00134)	(0.00133)	(0.00193)	(0.00160)	(0.00168)
ICT	0.00943***	0.00553***	0.00621***	0.00130	0.00691***	0.00713***
	(0.000511)	(0.000668)	(0.00129)	(0.000963)	(0.000752)	(0.000791)
ICT_Squared	-9.98e-05***	-5.89e-05***	-7.67e-05***	-2.23e-06	-7.60e-05***	-7.72e-05***
	(5.31e-06)	(9.95e-06)	(1.09e-05)	(1.09e-05)	(7.74e-06)	(8.10e-06)
Foreign direct investment	8.17e-05	-0.00264***	0.000176	0.00265**	-0.000181	-0.000188
	(0.000159)	(0.000882)	(0.000188)	(0.00134)	(0.000177)	(0.000189)
Financial development	-0.00108***	0.000880***	-0.000180	-0.00248***	2.43e-05	-3.47e-05
	(9.79e-05)	(0.000173)	(0.000122)	(0.000175)	(0.000202)	(0.000207)
Resource rents	2.42e-05	0.00376***	0.00314***	0.00472***	0.000767	0.00107*
	(0.000402)	(0.000486)	(0.00119)	(0.000954)	(0.000539)	(0.000571)
Trade openness	-0.000314***	1.47e-05	0.000230*	0.000627***	-0.000498***	-0.000337***
	(6.95e-05)	(0.000152)	(0.000136)	(0.000230)	(8.07e-05)	(8.27e-05)
GDP per capita	-0.0495***	0.0218***	-0.150***	0.00119	-0.0701***	-0.0819***
	(0.00390)	(0.00572)	(0.00621)	(0.00957)	(0.00639)	(0.00662)
Constant	-1.167***	-1.158***	1.377***	-2.705***	0.407	0.760**
	(0.180)	(0.251)	(0.329)	(0.489)	(0.354)	(0.373)
Threshold (tourism)	16.909	15.455	---	15.607	16.255	---
Threshold(ICT)	47.395	46.944	40.482	----	45.461	46.179
Observations	1,758	431	525	333	440	40
Pseudo-R-Squared	0.947	0.608	-0.5377	0.469	0.286	0.519
chi2	988.1***	388.7***	781.1***	404.2***	353.9***	371.7***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8. Non-linearity through income groups and level of political stability

VARIABLES	(1) Low-income countries	(3) Lower-middle income countries	(5) Upper-middle income countries	(7) High income countries	(9) Unstable countries	(11) Stable countries
	Dependent variable: Sustainable development index					
Tourism	0.0624	-0.101	0.0426*	0.112*	0.0122	0.325***
	(0.0504)	(0.0428)	(0.0329)	(0.0680)	(0.0444)	(0.0274)
tourism_Squared	-0.00170	0.00369**	-0.00139	-0.00334	0.000452	-0.0104***
	(0.00196)	(0.00152)	(0.00106)	(0.00209)	(0.00140)	(0.000927)
ICT	0.00706***	0.00122**	0.00284***	0.00463***	0.0136***	0.00714***
	(0.000935)	(0.000569)	(0.000700)	(0.00144)	(0.00112)	(0.000533)
ICT_Squared	-9.89e-05***	5.21e-06	-2.86e-05***	-5.26e-05***	-0.000129***	-7.95e-05***
	(1.84e-05)	(9.01e-06)	(7.81e-06)	(1.18e-05)	(9.87e-06)	(6.19e-06)
Foreign direct investment	-0.00272***	-0.000433	0.00420***	6.56e-05	0.000518**	-0.000897***
	(0.000704)	(0.000777)	(0.000861)	(0.000145)	(0.000235)	(0.000183)
Financial development	1.93e-07	0.000549***	-0.000781***	-0.000486***	-0.000450***	-0.000938***
	(0.000537)	(0.000180)	(0.000118)	(0.000126)	(0.000132)	(0.000142)
Resource rents	-0.00103	0.00154***	-0.000520	-0.000942*	-0.000163	-0.00155***
	(0.000757)	(0.000442)	(0.000463)	(0.000541)	(0.000774)	(0.000417)
Trade	0.000539**	0.000156	-8.16e-05	-0.000513***	-0.000469***	0.000152
	(0.000271)	(0.000109)	(0.000118)	(7.73e-05)	(8.29e-05)	(0.000102)
GDP per capita	-0.0226*	0.0316***	-0.0378***	-0.180***	-0.117***	0.00217
	(0.0114)	(0.00554)	(0.01000)	(0.0105)	(0.00704)	(0.00456)
Constant	0.00374	0.999***	0.709***	1.410**	1.127***	-1.953***
	(0.371)	(0.301)	(0.251)	(0.550)	(0.337)	(0.196)
Threshold (tourism)	-----	----	-----	---	----	15.625
Threshold (ICT)	35.693	-----	49.650	44.0114	52.713	44.906
Observations	142	517	467	632	687	1,071
Pseudo-R-Squared	0.330	0.284	0.141	0.132	0.178	0.390
chi2	124.1***	284.1***	130.9***	489.2***	625.5***	426.3***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From Table 7, a positive non-linear effect of tourism is apparent in the overall sample and across all continental groupings except for Europe and Oceania. In essence, at a tourism level of 16.909, 15.455, 15.607 and 16.255 (log of number of arrivals)[1] respectively for the overall sample, Africa, the Americas and Asia, the positive effect of tourism turns to be negative. Tourism enhances inclusive development through increase in literacy rate and educational quality though the effect is always affected by several factors. In fact, Biagi et al. (2017) argue that the effect of tourism on social development is non-linear, suggesting that above a certain threshold of tourism development, certain negative externalities are produced in the economy. Above the established thresholds, tourism could put enormous

[1]Given that these thresholds represent the logarithm of the number of arrivals, the actual value will be, e^z, with z, being the thresholds established for tourism in Tables 7 and 8. The real thresholds (number of tourism arrivals) is therefore,22053899.67, 5152538.17, 6010388.82, 11467184.59 respectively, for the overall sample, Africa, the Americas and Asia.

stress on local land use, leading to erosion, water overuse, air pollution and loss in natural habitations. These negative externalities which are degrading to the environment leads to a shrinkage in sustainable development. Looking at Table 8, the non-linear effect of tourism on inclusive development is not apparent across income groups, however, the positive non-linear effect is apparent in stable economies while the effects in unstable economies and low-income economies are non-significant. In effect, politically-unstable environments would not attract tourists, justifying the non-significant effect of tourism in unstable countries and positive significant effect in stable countries, though non-linear. At the same time, low-income countries lack the necessary funds required to build robust infrastructures that facilitate tourism development like roads, railways, hotels, *inter alia*. This justifies the non-significant effect in these group of countries. High income countries have the necessary funds required to invest in sectors that will help in curbing the negative externalities that come with increase in tourism. That justifies why the positive effect is non-linear for these groups of economies.

Also, Tables 7 and 8 show that ICT has a positive non-linear effect on sustainable development across the overall sample, continental clusters, income groups and level of political stability except for the Americas and lower-middle-income countries. At the early stages of ICT development, communications and research are facilitated leading to economic productivity and competiveness. These contribute to enhancing sustainable development. Equally, Adeola and Evans (2020) argue that ICT offers a huge opportunity for strengthening tourism development. In essence, ICT and ICT tools help in the publicity of the tourism companies and web developers have in recent decade developed ICT applications that help in boosting tourism by enabling the promotion and commercialization of local tourism potentials in international markets, reducing dependence on big foreign intermediaries (Petti and Passiante, 2009). Some of these recent technologies include TourCMR, a tourism application that exposes the tourism potential of Cameroon with all destinations and characteristics of all tourism sites exposed which tourist can easily visit and make destination choices. However, above the established ICT thresholds, the negative externalities associated with tourism also come with ICT given that the latter is a determinant of the former.

5. Conclusion and Policy implications

Despite the demonstrated importance of ICT and tourism for the economic development, and the rapid growth of these covariates in economies around the globe, economic development has not followed the same trend, though there are few exceptions. Since the adoption of the sustainable development goals in 2015, the global average of the sustainable development scores had been increasing except in 2019 when it started witnessing a drop. This corresponds to a period when global tourism went into recession because of the Covid-19 pandemic. Unfortunately, no study to the best of knowledge has examined the effect of tourism on inclusive development through the sustainable development scores approach. The objective of this study was therefore to examine the effect of ICT and tourism on inclusive development on a global perspective. The study contributed to literature first by examining the simultaneous effect of tourism and ICT on inclusive development. Past studies have focused on the effect of ICT (Nchofoung and Asongu, 2022 a), while that of tourism has been neglected. This study therefore considered both tourism and ICT as determinants of inclusive development. Secondly, this study approached inclusive development through the sustainable development index which is human development adjusted for environmental quality. Past studies on sustainable development have approached the subject through human development adjusted for inequality (Asongu and Boateng, 2018; Asongu and Nwachukwu, 2017a, 2017b; Asongu et al., 2017; Asongu and Le Roux, 2017; Nchofoung et al., 2021; Nchofoung et al., 2022 a). This study therefore used the human development adjusted for environmental sustainability, which is in line with the definition of Gupta et al. (2015) who defined inclusive development as development that involves all groups without compromising for the environmental needs of the future generations. Third, the study controlled for regional groupings and income levels and level of political stability. Fourth the study integrated non-linearity is the modelling framework which past studies on the subject neglected.

The data were collected for 142 countries between the 2000-2019 periods and the regression methodology involved the POLS, the Driscoll and Kraay (1998) estimator, the Mean Group, the System GMM and the fixed effects Tobit regression. The results of the regression showed that for the linear regressions, tourism enhanced inclusive development while ICT had a negative significant effect. While the effect of tourism was robust across income groups, regional groupings and regression methodologies, the effect of ICT was negative and varied across these different specifications. When non-linearity was considered, the effects of both ICT and tourism were positive and robustly non-linear. The non-linear effect of tourism was not however feasible across income groups. Besides, while the effect of tourism was positively and non-lineally related to sustainable development in politically-stable economies, the effect was non-significant in unstable economies.

From the results, the following policy recommendations emerged. Firstly, countries should seize the opportunity offered by the tourism sector and ICT as effective policy tools towards sustainable development. In this regard, countries should invest in both ICT and tourism to raise revenues in meeting the sustainable development agenda. However, above the established thresholds for non-linearity, complementary policies should be put in place. Secondly, politically-unstable economies should engage in peace talks such that they could join their politically-stable counterparts in benefiting from the positive economic effects offered by tourism and ICT.

The study is not however conclusive on the subject. Future studies on the subject could consider the different dimensions of the sustainable development indicators used in this study. Besides, country specific studies could be conducted for more oriented policies. Also, transmission mechanisms could be integrated in future studies.

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Appendix

A1. List of countries under study

Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Barbados, Belgium, Benin, Bhutan, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Congo Dem. Rep., Congo Rep., Costa Rica, Cyprus, Czech Republic, Côte d'Ivoire, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Estonia, Ethiopia,

Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kyrgyzstan, Laos, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Singapore, Slovenia, South Africa, Spain, Sri Lanka, Suriname, Swaziland, Sweden, Switzerland, Syria, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States of America, Uruguay, Viet Nam, Zambia, Zimbabwe