Journal of
Risk and Financial Management

MDPI

Article

Information and Communication Technology Adoption and Life Insurance Market Development: Evidence from Sub-Saharan Africa

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Abstract: As part of the Fourth Industrial Revolution (4IR), blockchain, fintech (financial technology), and insurtech (insurance technology) are some innovations that have been rolled out in the financial landscape and have captured the imaginations of policymakers and scholars alike. The African continent lags in embracing technology and is still grappling with financial access and enhancing financial inclusion. As such, it is bewildering whether African insurance markets are at a stage where they can leverage the possibilities offered by the 4IR. Against this backdrop, the aim of the study was to investigate whether information communication technology (ICT) adoption influences the development of African life insurance markets. We utilised a sample of 31 sub-Saharan African countries for the period 2005–2020. Panel data techniques were employed, and the pooled ordinary least squares, fixed effects, and random effect estimators were used to test the relationship between life insurance density and the measures for ICT adoption (proxied by fixed telephones, internet use, mobile cellular telephones, and broadband) as well as financial freedom being the control variable. We found that the life insurance market development variable was positively related to three of the four ICT adoption variables, namely, fixed telephone, mobile cellular telephone, and broadband. Further, the life insurance market development variable is positively related to the financial freedom variable. These findings suggest that ICT adoption fosters the development of the life insurance market in Africa. The findings also lend credence to the view that the degrees of financial freedom of insurance companies (who are unencumbered by regulations) have a bearing on the levels of insurance sales and, hence, promote life insurance access in Africa. The policy imperatives that flow from this study are that African governments must ensure that they (1) institute ICT adoption-friendly policies and (2) regulate the life insurance sector optimally, in order to foster the development of their life insurance sectors.

Keywords: life insurance; life insurance market development; ICT adoption; Fourth Industrial Revolution; sub-Saharan Africa; insurtech

Citation: Sibindi, Athenia Bongani. 2022. Information and Communication Technology Adoption and Life Insurance Market Development: Evidence from Sub-Saharan Africa. *Journal of Risk and Financial Management* 15: 568. https://doi.org/10.3390/jrfm15120568

Academic Editor: Sisira Colombage

Received: 24 October 2022
Accepted: 27 November 2022
Published: 30 November 2022

1. Introduction

The Fourth Industrial Revolution (4IR) has gained traction in the last few years. It has become imperative for the insurance industry to innovate and embrace technology in order to develop the sector. Insurtech (insurance technology) is developing rapidly and is replacing the traditional insurance model. Arguably, ICT adoption has fostered the insurtech revolution. As the 4IR revolution unfolds, it has become imperative to interrogate the role ICT adoption plays in the development of insurance markets.

The life insurance industry contributes immensely to the economic development of countries. The importance of insurance, such as other financial institutions, e.g., banking and the stock market, is vital for the sustainable economic growth of any country (Ul Din et al. 2017). According to Sibindi (2014), the life insurance sector plays a critical role in the economy due to its mechanism of promoting savings via life policies, and, hence, fostering intermediation. This viewpoint was also buttressed by Shi et al. (2015) who

documented that the human capital protection motive, asset allocation motive, and the breadth of a household's social connections have substantial impacts on life insurance demands in China.

The positive effects of insurance market development on economic growth have been documented in extant studies. For instance, Ward and Zurbruegg (2000) examined the relationship between economic growth and growth in the insurance industry for nine OECD countries and established that, in some countries, the insurance industry's Granger causes economic growth, and in other countries, the economic growth Granger causes the insurance sector development. Arena (2008) established that both life- and non-life insurance industries had positive and significant causal effects on economic growth. Further, Ćurak et al. (2009) established a positive relationship between insurance penetration and economic growth. Han et al. (2010) explored the relationship between insurance development and economic growth by employing a panel of 77 countries for the period 1994–2005 and found a positive association between insurance development and economic growth.

Horng et al. (2012) examined the relationship between insurance demand, financial development, and economic growth in Taiwan for the period between 1961 and 2006. They documented that there was an equilibrium relationship between demand, financial development, and economic growth. Further, Horng et al. (2012) established that economic growth was positively related to insurance demand. Whereas Lee et al. (2013) investigated the relationship between life insurance activities and economic growth by employing a panel of 41 countries. They established a long-running equilibrium relationship between economic growth and life insurance, with a 1% increase in real life premium GDP resulting in a 0.06% increase in real GDP.

Apergis and Poufinas (2020) examined the role of insurance in promoting economic growth by utilizing a sample of OECD countries as the unit of analysis. They found that gross claim payments and gross operating expenses, insurance penetration, and premiums were positively related to economic growth. Cheng and Hou (2021) analysed a panel of 17 advanced countries and found that life insurance development is a panacea in the finance-growth nexus as it promotes long-term growth. More recently, Gonzalez et al. (2022) re-examined the insurance-growth nexus by employing a panel of 90 countries as a unit of analysis and took into consideration cross-sectional dependence. They established that the insurance and economic growth panels were cointegrated. Segodi and Sibindi (2022) also examined the determinants of life insurance demand and established a positive link between life insurance demand and economic growth in BRICS countries for the period 1999 to 2020.

The present inquiry was borne out of the realisation that, notwithstanding the fact that the insurance sector plays a critical role in the economy, it remains underdeveloped in Africa. Insurance penetration levels are low. It is trite to highlight that financial inclusion in general and insurance inclusion in particular are the channels through which some of the sustainable development goals (SDGs) could be attained. As such, the policy syndrome that the present study seeks to address is to unravel whether ICT adoption can foster the development of the insurance market and, thereby, spread the envelope of insurance inclusion. Notwithstanding that extensive studies have examined the relationship between economic growth and insurance growth, there is a dearth of studies that have examined the effect of ICT adoption on the life insurance development.

Against this backdrop, the aim of the present study was to investigate whether information communication technology has an impact on the life insurance market development in African countries. The remainder of the paper is arranged as follows: the next section reviews the literature on ICT adoption and economic growth. Section 3 presents an overview of the application of ICT in the life insurance sector. Section 4 presents the research methodology applied to execute the study. Section 5 presents the empirical results and discusses the research findings of the study. Section 6 concludes the study.

2. Review of Related Literature

The ICT life insurance market development nexus draws from studies on the ICT economic growth nexus, which has gained prominence in the last decade. The impact of ICT on economic growth has been examined in extant studies. Most studies in this realm document a positive relationship between ICT and economic growth. Notwithstanding, to the best of this researcher's knowledge, no existing study has examined the role of ICT adoption on life insurance market development.

The first strand of studies that examined the ICT economic growth nexus documented positive relationships, including studies by Vu (2013) and Jin and Cho (2015). Further, Toader et al. (2018) examined the effect of using ICT infrastructure on economic growth in EU countries for the period 2000 to 2017. They established that there was a strong and positive effect of using ICT infrastructure on economic growth, but the magnitude of the effect differed depending on the technology examined. Moreover, Haftu (2019) analysed the impacts of mobile phones and the internet on the per capita income of SSA countries for the period 2006 to 2015 and established a positive relationship between mobile phone penetration and per capita GDP. However, the internet variable had an insignificant effect on per capita GDP.

The second strand of studies examined the causal relationship between ICT and economic growth. The studies that characterise the ICT-growth nexus can be surmised as follows: (1) there is no causal relationship; (2) the causal relationship is demand-following, i.e., economic growth leads to a demand in ICT infrastructure; (3) the causal relationship is supply-leading, in which ICT infrastructure is a necessary condition to spur economic growth; and (4) interdependence—ICT infrastructure and economic growth reinforce one another. Amongst others, Pradhan et al. (2017) documented a causal relationship between ICT penetration, financial development, and economic growth in Next-11 countries between 1961 and 2012. Further Pradhan et al. (2018) established that there was a cointegrating relationship between economic growth and ICT infrastructure in G-20 countries for the period 2001–2012. More recently, David (2019) examined the relationship between telecommunication infrastructures, economic growth, and development in selected African countries and established bidirectional long-run relationships.

There is a growing strand of studies examining the nexus between ICT and insurance development. In this realm of studies, Asongu and Odhiambo (2020) examined the impact of ICT on both life- and non-life insurance industries by employing a panel study of 48 countries for the period 2004–2014. They documented a positive relationship between ICT adoption and life insurance consumption. The results of their study also established a positive relationship between ICT adoption (proxied by fixed broadband subscriptions) and non-life insurance penetration.

Benlagha and Hemrit (2020) analysed the effect of internet use on insurance. They utilised OECD countries as a unit of analysis for the period 2007 to 2017 and employed panel data techniques in their analysis. They found that internet use was positively related to non-life insurance activities. Notwithstanding the results of their study documented no significant relationship between internet use and life insurance consumption.

Akinlo (2021) explored the nexus between information technology and insurance development by employing a sample of 40 sub-Saharan African countries and utilising a system generalised method of moments for the period 2000–2017. The results of the study documented a positive relationship between the internet variable and non-life insurance while its effects on life and total insurance were insignificant. Further Akinlo (2021) established that the fixed telephone (ICT adoption proxy) was positively related to the life insurance, non-life insurance, and total insurance variables.

Molloy and Ronnie (2021) set out to establish how the South African life insurance industry could be better equipped to face the 4IR via an exploratory, qualitative inquiry. They found that resistance to change within the industry, lack of urgency, lack of agility, partnerships, ecosystems, and the abilities of people and leaders were major factors that management needed to contend with in order to successfully navigate the 4IR.

Asongu et al. (2020) explored the role of information and communication technology (ICT) in modulating the effect of governance on insurance penetration in 42 Sub-Saharan African countries They found that, on the one hand, the internet penetration variable positively modulates the governance variables of political stability, government effectiveness, and rule of law to induce on life insurance. On the other hand, they established that the internet penetration variable had a positive modulating effect on the corruption–control for an overall positive effect on non-life insurance. Asongu et al. (2020) also established that fixed broadband subscriptions promoted life insurance development via governance channels of regulation quality, government effectiveness, and the rule of law.

From the foregoing, it is evident that ICT adoption has an impact on economic growth. In the majority of cases, the casual relationship runs from ICT infrastructure to economic growth, which is consistent with the supply-leading hypothesis. Notwithstanding that research on the ICT-insurance development nexus is still in its infancy, it seems as if the predominant relationship is a positive one. The present study takes cues from such studies. We conjecture that ICT has a significant and positive effect on the development of life insurance in the same manner that ICT influences economic growth.

3. Application of ICT Infrastructure in the Life Insurance Sector

Arguably, life insurance development is fostered by ICT adoption as the latter results in greater operational efficiency of the life insurer. This is illustrated in Table 1. In the main, the fixed telephone and mobile telephone systems can be employed by insurance agents, to a great effect, in waging a telemarketing campaign to increase life insurance sales. Through the use of voice logging, it has also become easier for life insurers to underwrite risks over the phone, obviating the need for the proposer of a life insurance policy to complete a proposal form.

Table 1. ICT infrastructure application in life insurance.

ICT Infrastructure	Application in Life Insurance
Fixed Telephone	Telemarketing campaigns Underwriting Claims settlement Policy servicing
Mobile Telephone	Telemarketing campaigns Internet of Things fosters behavioural underwriting Distribution Policy servicing
Internet	Distribution Claims processing Policy servicing
Broadband	Distribution Claims processing Policy servicing

Source: author's own compilation.

For the technologically savvy insurer, the mobile phone application enables a life insurer to collect behavioural data of the insured, for instance, which relates to physical exercise and idleness. With these data, the insurer will be able to charge a far more equitable insurance premium. The ICT infrastructure thus enables the insurer to service the insured more efficiently in a number of ways. Firstly, the lead times between the applications for life insurance and the acceptance of the cover greatly reduce. Secondly, the lead time between the lodging of a claim and its settlement can be greatly reduced as the insured can now submit his/her claim promptly using, for instance, email. Moreover, the insured can keep track of his/her benefits as policies become accessible over the internet. In essence,

the higher the operational efficiency of the insurance company, the higher the customer satisfaction, leading to greater life insurance sales.

4. Research Methodology

4.1. Sample Description and Data Sources

The population for the study was from sub-Saharan African (SSA) countries. The sample consisted of all SSA countries with complete datasets for the period 2005 to 2020. There were 31 countries: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Cote d'Ivoire, DRC, Ethiopia, Gabon, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa Swaziland, Tanzania, Togo, Uganda, and Zambia.

The data on insurance density, financial freedom, and ICT adoption were obtained from the World Bank Global Financial Development, Heritage Foundation, and International Telecommunication Union databases, respectively.

4.2. Empirical Model Specification and Estimation Techniques

The aim of the present study was to investigate whether ICT adoption has a significant impact on the development of life insurance markets in sub-Sahara Africa.

The following static panel data model was specified to address the aim of the study:

$$LID_{i,t} = ICT_{j,i,t}\beta_1 + FIF_{i,t}\beta_2 + \alpha_i + \varepsilon_{i,t} \quad (1)$$

where:

$LID_{i,t}$ = loglid (life insurance density in logarithmic form) for country i at time t.
$ICT_{j,i,t}$ = ICT adoption in country i (for i = 1, 2, 3 . . . 31) at time t (t = 1, 2, 3 . . . and 16), for j = 1, 2, 3 and 4, are:

(1) Fixed-telephone subscriptions per 100 inhabitants (logfix), for j = 1;
(2) Fixed-broadband subscriptions per 100 inhabitants (logbr), for j = 2;
(3) The percentage of individuals using the internet (login), for j = 3;
(4) Mobile–cellular telephone subscriptions per 100 inhabitants (logmob), for j = 4

$FIF_{i,t}$ = logfin (financial freedom score in logarithmic form) for country i at time t.
β = a vector of slope parameters
α_i= group-specific constant term which embodies all the observable effects.
$\varepsilon_{i,t}$ = composite error term, which also takes care of other explanatory variables that equally determine life insurance density but are not included in the model.

4.3. Variable Definition

In this study, the dependent variable employed to proxy life insurance market development was life insurance density expressed in logarithmic form. The independent variables consisted of the ICT development variables and the financial freedom variable, all taken in logarithmic form. The variables and data sources are described in Table 2.

Table 2. Definition of variables and sources of data.

Variable	Description	Data Source
	Dependent Variable	
loglid	Life insurance density is the ratio of the life insurance premium volume to GDP % (logarithmic values)	World Bank
	Independent Variables	
logfin	Financial freedom score (logarithmic values)	Heritage Foundation
logfix	Fixed-telephone subscriptions per 100 inhabitants (logarithmic values)	ITU
logmob	Mobile–cellular telephone subscriptions per 100 inhabitants (logarithmic values)	ITU
login	Percentage of Individuals using the Internet (logarithmic values)	ITU
logbr	Fixed-broadband subscriptions per 100 inhabitants (logarithmic values)	ITU

Source: author's own compilation.

5. Empirical Results and Discussion of Findings

This section presents the summary statistics, diagnostic test results, and empirical results, as well as discusses the findings of the study in relation to related studies in this realm.

5.1. Summary Statistics

This section presents the summary statistics of the main variables for the study. These are presented in Table 3. The mean life insurance density reported by the sample countries was 0.85%. The maximum life insurance density reported by sub-Saharan African countries for the sample period was 12.34%.

Table 3. Summary statistics.

Variable	N	MEAN	SD	MINIMUM	MAXIMUM	SKEW	KURTOSIS
LID	496	0.8577	2.1034	0.02	12.34	4.0138	19.2728
FIX	496	3.2454	5.9310	0	32.6526	3.1625	13.7624
BR	496	0.6980	2.1613	0	19.4445	5.8533	41.2594
IN	496	10.9937	12.4997	0.2153	57.1621	1.6999	5.3902
MOB	496	56.8975	38.7184	0.5351	159.1563	0.6943	2.8160
FIN	496	44.9627	13.5009	20	70	-0.1499	2.5902

The mean number of people owning a fixed telephone line was 3 in 100 with a maximum of roughly 33%. For the broadband ICT adoption indicator, the mean number of people owning one was 1 person in 100. With regard to internet use, the statistics were better, as close to 11% used the internet, with a maximum of 60% utilising the same, for the sample period. Comparatively, when it comes to the ownership of a mobile gadget, the statistics were much better; on average, 57% of the population in sub-Saharan African countries owned a mobile phone for the period under review.

5.2. Diagnostic Tests

Four models were estimated for each ICT adoption measure to avoid multicollinearity. The first model employed the fixed telephone as the ICT adoption measure. The second model employed mobile cellular as the ICT adoption measure. The third model adopted the internet as the ICT adoption measure. Lastly, the fourth model employed broadband as the ICT adoption measure. To estimate a robust model that best describes the relationship between ICT adoption and life insurance development, four tests of the specification were performed, namely, the test for poolability of panel data via the applied Chow test; the Breusch and Pagan (1980) LM test for random effects; the Hausman (1978) specification test,

and the modified Wald test for groupwise heteroscedasticity. The results of the diagnostics tests are documented in Table 4.

Table 4. Diagnostic Tests.

Test	Test Statistic	Probability	Inference
Joint validity of cross-sectional individual effects $H_0: \alpha_1 = \alpha_2 = \ldots \alpha_{N-1} = 0$ $H_A: \alpha_1 \neq \alpha_2 \neq \ldots \alpha_{N-1} \neq 0$	$F_1 = 103.58$ $F_2 = 140.28$ $F_3 = 161.10$ $F_4 = 146.38$	$p = 0.000$ $p = 0.000$ $p = 0.000$ $p = 0.000$	Cross-sectional specific effects are valid.
Breusch and Pagan (1980) LM test for random effects $H_0: \delta_\mu{}^2 = 0$ $H_A: \delta_\mu{}^2 \neq 0$	$LM_1 = 1408.65$ $LM_2 = 1412.63$ $LM_3 = 1549.82$ $LM_4 = 1395.08$	$p = 0.000$ $p = 0.000$ $p = 0.000$ $p = 0.000$	There are significant differences in variances across the entities. Random effects are present.
Hausman (1978) specification test $H_0: E(\mu_{it}\|X_{it}) = 0$ $H_A: E(\mu_{it}\|X_{it}) \neq 0$	$m_1 = 30.82$ $m_2 = 8.85$ $m_3 = 10.69$ $m_4 = 10.75$	$p = 0.000$ $p = 0.012$ $p = 0.004$ $p = 0.005$	Regressors are not exogenous. Hence, the fixed effects specification is valid.
Heteroscedasticity $H_0: \delta_i{}^2 = \delta$ *for all i* $H_0: \delta_i{}^2 \neq \delta$ *for all i*	$LM_1 = 100{,}000$ $LM_2 = 210{,}000$ $LM_3 = 6241$ $LM_4 = 5246$	$p = 0.000$ $p = 0.000$ $p = 0.000$ $p = 0.000$	The variance of the error term is not constant. Heteroscedasticity is present.

The results of the applied Chow test or F-test indicated the validity of cross-sectional effects for all four models. The Breusch and Pagan (1980) Lagrange multiplier (LM) test for heteroscedasticity or serial correlation revealed that the variance of the error term was non-constant. This rendered estimation with OLS inappropriate. According to the Hausman specification test results, the fixed effects model was deemed to be the most appropriate estimator in all four estimations. The modified Wald test for groupwise heteroscedasticity was positive in all four estimations, indicating the presence of heteroscedasticity. This renders the estimated coefficients inconsistent. As such, to mitigate this, estimation was conducted in the context of the fixed effects with Driscoll and Kraay (1998) standard errors.

5.3. Correlational Analysis

This section presents the correlation matrix and describes the association between the variables of interest.

The correlation matrix is presented in Table 5. The life insurance density variable is positively correlated to the fixed telephone variable and the result is highly significant at the 1% level of significance. Likewise, there is a positive, highly significant association between the life insurance density and the other ICT adoption proxies, namely, broadband, internet use, and mobile. Further, the results of the study documented a positive correlation between life insurance density and the financial regulation variable. The correlations between the ICT adoption measures are very high and exceed 0.70, indicating a problem of multicollinearity should these variables be regressed together. As such, they are regressed in separate models.

Table 5. Correlation matrix.

	LOGLID	LOGFIX	LOGBR	LOGIN	LOGMOB	LOGFIN
LOGLID	1.0000					
LOGFIX	0.5208 *	1.0000				
LOGBR	0.4856 *	0.5835 *	1.0000			
LOGIN	0.4425 *	0.4594 *	0.7494 *	1.0000		
LOGMOB	0.4099 *	0.4085 *	0.7258 *	0.8317 *	1.0000	
LOGFIN	0.3563 *	0.4282 *	0.3011 *	0.2636 *	0.1888 *	1.0000

* Indicates the 1% level of significance.

5.4. Empirical Results and Discussion of Findings

The empirical results of the study are presented in Table 6. The results document a positive and significant effect of the ICT adoption variables on life insurance density. The results document that a 1% increase in the use of mobile phones will result in a 0.217% increase in life insurance density. Comparatively, a 1% increase in the use of the internet results in a 0.204% increase in life insurance density. In contrast, Benlagha and Hemrit (2020) found that internet use did not affect life insurance consumption. Further, a 1% increase in the use of broadband resulted in a 0.109% increase in life insurance density. On the other hand, a 1% increase in the use of fixed telephones resulted in a 0.159% increase in life insurance density. This finding is consistent with the studies on the relationship between ICT adoption and life insurance density.

Table 6. Panel regression results.

Model	(1)	(2)	(3)	(4)
	Model: Fixed Effects with Driscoll and Kraay (1998) Standard Errors			
Variables	Dependent Variable: LOGLID			
LOGFIX	0.159 *** (3.37)			
LOGBR		0.108 *** (7.18)		
LOGIN			0.204 *** (10.46)	
LOGMOB				0.217 *** (8.62)
LOGFIN	0.3644 ** (2.11)	0.1423 ** (2.48)	0.076 (0.52)	0.057 *** (3.26)
constant	0.093 (0.14)	−1.557 ** (-2.27)	−1.440 ** (2.45)	−1.942 *** (−3.07)
Adjusted R^2	0.444	0.367	0.406	0.218

(**) and (***) indicates the (5%) and (1%) level of significance respectively. The t-statistics are reported in parentheses.

Among others, Asongu and Odhiambo (2020) reported that mobile phone penetration and fixed broadband subscriptions had a positive net effect on the life insurance consumption. Akinlo (2021) also found that a fixed telephone had a positive and significant effect on life insurance. The results largely document a positive significant relationship between financial freedom and life insurance demand; a 1% increase in the former results in a 0.364% increase in the latter. This is consistent with the results of Segodi and Sibindi (2022).

6. Conclusions

The primary aim of the study was to establish whether information communication technology has an impact on life insurance market development in African countries. The study employed a panel of 31 African countries for the period 2005 to 2020. Panel data techniques were employed in the estimation.

Firstly, the results of this study demonstrate that ICT infrastructure has a positive and significant effect on the development of life insurance markets in South Africa. Secondly, the findings of the study demonstrate that the level of financial freedom has a bearing on the development of life insurance markets in Africa.

As such, it is incumbent upon policymakers in Africa to develop ICT policies that will also benefit the life insurance industry, especially in the wake of the 4IR. On the one hand, these policies could focus on the demand side. Such policies could be geared toward improving ICT infrastructure, such as mobile phones, internet, and broadband connectivity to reach as many people as possible. Arguably this could spur the demand

for life insurance. On the other hand, the ICT policies could be targeted on the supply side. These policies could focus on promoting fintechs that can partner with life insurance companies to distribute life insurance products. It is also imperative that policymakers in Africa desist from overregulating the life insurance industry as that stifles innovation by the sector and curtails life insurance penetration.

The limitation of the study is two-fold. Firstly, it did not include all other control variables, which could affect life insurance development, such as financial literacy, interest rates, and rule of law, among others. Secondly, it did not consider the effect of the COVID-19 pandemic on life insurance development. It is conceivable that lockdowns accelerated the ICT adoption as well as the demand for life insurance policies. Future studies could consider these research avenues.

Funding: The APC was funded by the University of South Africa.

Data Availability Statement: Data available upon request.

Conflicts of Interest: The author declares no conflict of interest.

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