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INSURANCE POLICY THRESHOLDS FOR ECONOMIC GROWTH IN AFRICA

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Abstract

This study investigates the role of insurance in economic growth on a panel of forty-eight countries in Africa for the period 2004-2014. The research question the study seeks to answer is the following: what thresholds of insurance penetration positively affect economic growth in Africa? The empirical evidence is based on Generalized Method of Moments. Life insurance increases economic growth while the effect of non-life insurance is not significant. Increasing both life insurance and non-life insurance has negative net effects on economic growth. From an extended analytical exercise, 4.149 of life insurance premium (% of GDP) is the minimum critical mass required for life insurance to positively affect economic prosperity while 1.805 of non-life insurance premium (% of GDP) is the minimum threshold required for non-life insurance to positively affect economic prosperity. Thresholds are also provided from the Hansen (1999) Panel Threshold Regression technique using a balanced sample of 28 countries.

Keywords: Insurance; Economic Growth
JEL Classification: I28; I30; G20; O16; O55

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1. Introduction

Two main factors motivate the positioning of this study on the relevance of insurance in economic growth in Africa, notably: the potential for insurance penetration on the continent and gaps in the literature. The two factors are substantiated in chronological order.

First, in accordance with Kyerematen (2015), the penetration of insurance in Africa is substantially low relative to other regions of the world. The study maintains that except for South Africa which has an emerging insurance market, only about 5% of the African population has access to insurance services. The low penetration of insurance, which is closely linked to low levels of financial development, still represents a critical challenge to doing business in Africa (Asongu & Odhiambo, 2019a) in spite of the documented positive externalities of insurance in doing business and economic development on the continent (Guerineau & Sawadogo, 2015; Alhassan & Biekpe, 2016a, 2016b). The low penetration can represent an opportunity for economic development if it is leveraged in the light of development challenges in the continent. To this end, it will be relevant for policy makers to implement measures that increase insurance penetration in the continent. Moreover, such policies need to be supported with empirical evidence on the nexus between insurance penetration and development outcomes. This research is concerned with the relationship between insurance penetration and economic growth and aims to provide policy makers with specific thresholds or critical masses at which insurance improves economic prosperity. The concern of this research is also motivated by an apparent gap in the contemporary insurance literature.

Second, while empirical studies on the relationship between economic development and life insurance have focused on both developed and developing countries (Ward & Zurbruegg, 2000; Arena, 2008; Chang & Lee, 2012; Chen et al., 2012; Lee et al., 2013a, 2013b; Sawadogo et al., 2018), the positioning of this study is specifically in the space of contemporary Africa-centric literature because this articulates how its positioning departs from attendant Africa-centric studies. Hence, as critically engaged in Section 2, the extant literature on insurance consumption in Africa has focused on two main strands, notably: nexuses between the penetration of insurance and economic development (Ioncică *et al*., 2012; Akinlo, 2015; Alhassan & Biekpe, 2015, 2016a) and factors that determine insurance penetration (Zerriaa *et al*., 2017; Guerineau & Sawadogo, 2015; Alhassan & Biekpe, 2016b). This research is closest to the former strand, and unfortunately, studies in the attendant strand have a common shortcoming

of not clearly articulating thresholds of insurance penetration at which further consumption of insurance enhances economic prosperity.

In order to put the identified shortcoming into greater perspective, Akinlo (2015) has investigated the causal relationship between insurance and economic growth in thirty Sub-Saharan African (SSA) countries for the period 1995-2011 to establish bidirectional causality. In another study, the nexus between insurance penetration and economic growth has been established in eight countries in Africa for the period 1990-2010. The authors conclude on mixed, unidirectional and bidirectional causalities for the sampled countries.

In the light of the above findings, in this research, we argue that it is not enough to simply establish linkages between macroeconomic variables. Accordingly, establishing that insurance penetration affects economic growth and vice versa has less policy relevance unless the established nexuses are accompanied with specific policy thresholds at which insurance penetration affects economic growth and vice versa. This research addresses the identified gap by clearly establishing insurance thresholds that are favorable for economic prosperity. By so doing, policy makers are informed on the specific critical masses of insurance penetration required to stimulate economic growth. Moreover, by focusing on a sample of 48 countries for the period 2004-2014, the research also departs from the underpinning studies by using more updated data and focusing on a broader sample of countries. The research question this study seeks to answer is the following: what thresholds of insurance penetration positively affect economic growth in Africa?

The findings show that 4.149 % of life insurance premium (% of GDP) is the minimum critical mass required for life insurance to positively affect economic prosperity while 1.805% of non-life insurance premium (% of GDP) is the minimum threshold required for non-life insurance to positively affect economic prosperity in the sampled countries. These thresholds have policy relevance and make economic sense because they are within the acceptable economic ranges of life and non-life insurance premiums.

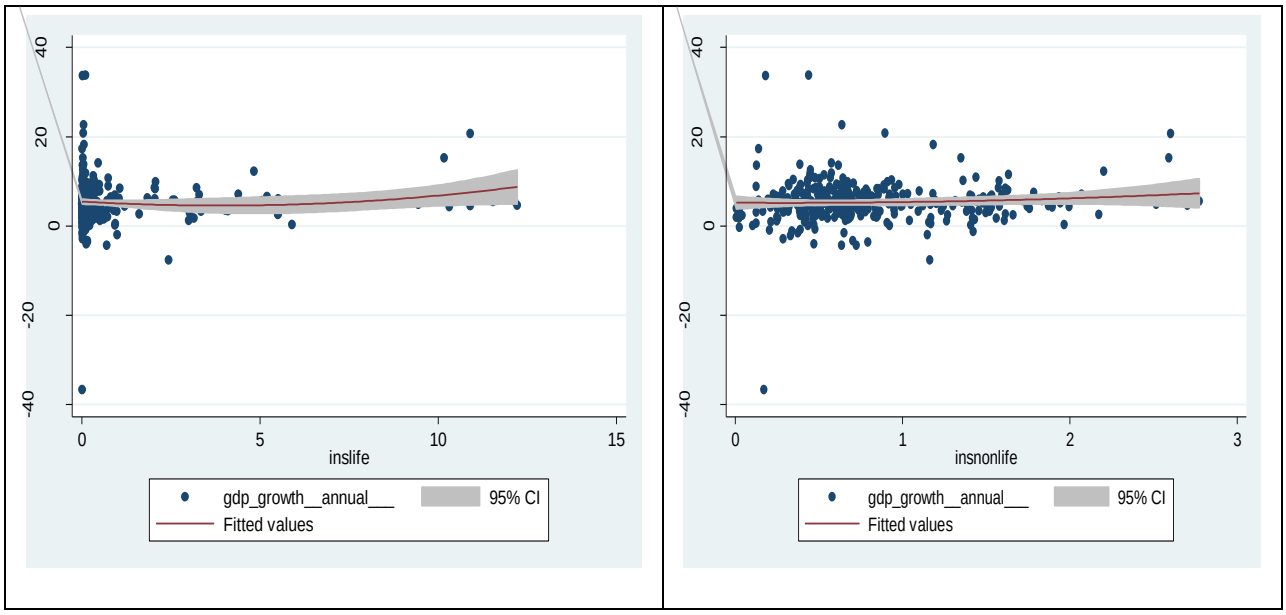
The rest of the study is structured as follows. Graphical insights, the intuition and literature review are covered in section 2 while section 3 focuses on the data and methodology. The empirical results are disclosed in section 4 while section 5 concludes with future research directions.

2. Graphical insights, Intuition and Insurance in Africa

2.1 Graphical insights

The anticipation of thresholds from non-linear nexuses between economic growth and insurance dynamics is apparent from the graphs below. In Figure 1, the graph on the left-hand side shows the linkage between life insurance and economic growth while the graph on the right-hand reveals the nexus between non-life insurance and economic growth. From the graphs, the relationships between insurance dynamics and economic growth are non-monotonic: these are indications that non-linear nexuses exist between the two variables. From the graphs, the relationships between insurance dynamics and economic growth are non-monotonic: these are indications that non-linear nexuses exist between the two variables, an issue that will be explored in Section 4.

Figure 1: Insurance and Economic Growth in Africa



Notes: The values used in plotting the graphs which are defined in Appendix 1 are annual observations of GDP growth and insurance premiums for the period 2004-2014 from 48 African countries. GDP growth (*gdp_growth_annual__*) is in annual percentage while life insurance (*inlife*) and non-life insurance (*insnonlife*) premiums are in percentages of GDP.

2.2 Intuition

In this study, we are fully conscious of the potential risks of doing measurement without an attendant theoretical underpinning. However, this research argues that the aim and end of applied econometrics should not be exclusively limited to empirical exercises that are motivated by the need to confirm or reject existing theoretical underpinnings. Hence, we submit that

applied econometrics that is motivated by sound intuition is a useful scientific activity that could lead to theory-building and provide relevant policy implications. While the policy relevance of this study in the light of extant contemporary literature has been clearly articulated in the introduction, in this section, we substantiate the intuition motivating the connection between insurance and economic growth. In so doing, the study is in accordance with the extant empirical literature on the usefulness of applied econometrics that is substantiated with sound intuition (Costantini & Lupi, 2005; Narayan *et al*., 2011; Asongu & Nwachukwu, 2016a)

The intuition for an association between insurance and economic growth is based on the view that insurance provides leverage against negative macroeconomic shocks that can substantially curtail economic activity. Moreover, by offering financial protection to all segments of society, insurers reduce the uncertainty that is associated with a macroeconomic environment (OECD, 2017). It is worthwhile to emphasise that investors have been documented to prefer less uncertain economic environments (Kelsey & le Roux, 2017, 2018).

Insurance can promote growth by *inter alia*: generating financial resources through the collection of premiums. These mobilized funds are subsequently invested in stock and government securities. The mobilized financial resources are also used for productive investments, industrial development and employment. In summary, insurers enable the mitigation of loss, promote trade, and enhance financial stability which ultimately leads to economic growth and economic development. Kumari (2016) maintains that insurance plays a paramount role in sustainable economic prosperity.

2.3 Literature review on Insurance in Africa

In the light of the discourse in the introduction, the extant literature on insurance in Africa can be discussed in two main strands, notably: determinants of life insurance consumption (Guerineau & Sawadogo, 2015; Alhassan & Biekpe, 2016b; Zerriaa *et al*., 2017) and linkages between insurance penetration and development outcomes (Ioncică *et al*., 2012; Akinlo, 2015; Alhassan & Biekpe, 2015, 2016a). The two dimensions are expanded in the paragraphs that follow.

Concerning the first strand pertaining to determinants of insurance consumption, Guerineau and Sawadogo (2015) have focused on twenty countries over the period 1996-2011. After controlling for potential endogeneity issues using an instrumental variable estimation technique, the authors establish that there is a positive relationship between per capita income

and life insurance premium. Moreover, life insurance development is negatively linked with young dependency ratios and life expectancy whereas the following factors are positively associated with it, namely: property rights protection, government stability and old dependency ratios.

Zerriaa *et al*. (2017) investigate the drivers of life insurance in Tunisia using annual data over the period 1990-2014. The results reveal that inflation and interests have no significant effects on the outcome variable. Conversely, pension expenditures reduce the demand for life insurance while the following factors engender negative effects: life expectancy, dependency, income, financial development and urbanization.

Determinants of life insurance consumption have been examined by Alhassan and Biekpe (2016b) in a panel of thirty-one African countries during the period 1996-2010. The authors establish that relative to financial determinants, demographic factors are more relevant in explaining life insurance in the sampled countries. Furthermore, the authors also conclude that life insurance is mitigated by dependency, inflation and life expectancy, while, positive impacts result from institutional quality, financial development, health expenditure and insurance consumption.

In the second strand, Akinlo (2015) assesses the causal linkage between insurance and economic prosperity in thirty countries in SSA over the period 1995-2011. Employing panel data with a heterogeneous panel causality estimation technique, the findings reveal bidirectional causality between insurance penetration and economic prosperity. Furthermore, the main feature of causality is that the causality is homogenous across the sampled countries.

The connection between productivity, efficiency and economies of scale in the non-life insurance market has been examined by Alhassan and Biekpe (2015). The authors have focused on South Africa using data for the period 2007-2012 and employing a battery of estimation approaches, namely: data envelopment analysis, logistic estimation and bootstrapped regression. The results show that about 20% of insurers optimally perform their operations whereas non-life insurers are associated with approximately 50% inefficiency. The findings reveal that improvements in productivity are contingent on technological ameliorations as well as a non-linear impact of size on constant returns to scale and efficiency. The authors also establish that leverage, reinsurance and product line diversification have significant nexuses with constant returns to scale and efficiency.

Alhassan and Biekpe (2016a) focus on selected African countries when investigating the nexus between insurance penetration and economic prosperity, namely: Algeria, Gabon, Kenya, Madagascar, Mauritius, Morocco, Nigeria and South Africa. Building on a sample for the period 1990-2010 and employing an autoregressive distributed lag (ARDL) approach, the findings show that there is a long run nexus between the insurance market and economic prosperity in the following countries: Kenya, Mauritius, Morocco, Nigeria and South Africa. Furthermore, findings from a vector error correction model (VECM) empirical setting reveal, *inter alia*: mixed causality in Gabon, unidirectional causality in Madagascar and Algeria and bidirectional causality in Morocco. The departure of this research from the second strand of the literature has been discussed in the introduction.

3. Data and methodology

3.1 Data

The study uses an unbalanced panel of 48 countries in Africa with data for the period 2004-2014[3]. The geographical and temporal scopes of the research are motivated by data availability constraints at the time of the study. The data come from three main sources, notably: (i) World Development Indicators of the World Bank for the dependent variable (i.e. economic growth) and a control variable (i.e. mobile phone penetration); (ii) World Governance Indicators of the World Bank for the a control variable (i.e. political stability) and (iii) the Financial Development and Structure Database (FDSD) of the World Bank for the insurance indicators (i.e. life insurance and non-life insurance). Accordingly, the study uses all the insurance variables provided by the FDSD.

Two control variables are adopted in order to account for variable omission bias, namely: mobile phone penetration and political stability. The limitation to two control variables is motivated by the fact that after a preliminary empirical assessment, it is apparent that accounting for more than two variables in the conditioning information set leads to instrument proliferation that biases the estimated models. This is mainly because, even when the instruments are collapsed in the specification exercise, the estimated models still fail to pass post-estimation

[3]The 48 countries include: "Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo Democratic Republic, Congo Republic, Côte d'Ivoire, Djibouti, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda and Zambia".

diagnostic tests. The restriction of the number of variables in the Generalized Method of Moments (GMM) specification is not uncommon in the literature because some studies in the empirical literature using the GMM have used limited (i.e. two control variables) indicators in the conditioning information set (Bruno *et al*., 2012) or zero control variable (Osabuohien & Efobi, 2013; Asongu & Nwachukwu, 2017)[4].

The two control variables are expected to promote economic growth. Accordingly, from intuition, political stability provides enabling conditions for the economic activities that generate economic growth through *inter alia*: investment, trade, consumption and government expenditure. The relevance of mobile phone penetration in economic growth has not been firmly established in the literature because there are studies supporting positive, insignificant and negative relationships (Chavula, 2013). This is mainly because the effect is contingent on other dynamics such as income levels which we cannot control in the present empirical exercise because fixed effects are not accommodated by the GMM approach. Hence, the research expects the mobile phone to significantly affect the outcome variable without any prior anticipated sign.

The definitions and sources of variables are provided in Appendix 1 whereas the summary statistics are disclosed in Appendix 2. The correlation matrix is covered in Appendix 3.

3.2 Generalised Method of Moments: specification, identification and exclusion restrictions

This adoption of this estimation approach is motivated by a strand of insurance-centric literature which has used the GMM approach to assess the nonlinear nexus between insurance penetration and economic development (Chang *et al*., 2012; Sawadogo *et al*., 2018). Moreover, the GMM estimation strategy is adopted for three main reasons (Tchamyou, 2019a, 2019b; Fosu & Abass, 2019). First, the data structure of the study is such that the number of cross sections is higher than the corresponding number of periods in each cross section. Hence, the N(48)>T(11) condition for the application of a GMM technique is fulfilled. Second, the fact that a panel data structure is involved in the analysis implies that cross-sectional variations are accommodated in

[4] Our justification for employing two control variables in the GMM specification is very solid because employing more than two variables will lead to findings that do not pass all post-estimation diagnostic tests owing to instrument proliferation, even when the option of collapsing instruments is taken on board in the estimation exercise. There is a choice here between having valid estimated models and avoiding variable omission bias. Hence, adding more control variables will produce invalid estimations (Bruno *et al*., 2012; Osabuohien & Efobi, 2013; Asongu & Nwachukwu, 2017; Asongu & Odhiambo, 2019b; Tchamyou, 2019a, 2019b).

the estimation exercise. Third, the issue of endogeneity is addressed from two main viewpoints. On the one hand, the employment of time-invariant omitted variables in the conditioning information set enables the study to control for the unobserved heterogeneity which is a dimension of endogeneity. On the other hand, the issue of simultaneity or reverse causality is tackled by means of instrumental variables.

Compared to traditional GMM approaches that have been documented to be less efficient, this research adopts the Roodman (2009a, 2009b) extension of Arellano and Bover (1995) which has been documented to be better at producing more efficient estimates and limiting instrument proliferation (Love & Zicchino, 2006; Baltagi, 2008; Asongu & Nwachukwu, 2016b; Boateng *et al*., 2018).

The following equations in level (1) and first difference (2) summarise the standard *system* GMM estimation procedure.

$$G_{i,t} = \sigma_0 + \sigma_1 G_{i,t-\tau} + \sigma_2 IS_{i,t} + \sigma_3 ISIS_{i,t} + \sum_{h=1}^{2} \delta_h W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \quad (1)$$

$$\begin{aligned} G_{i,t} - G_{i,t-\tau} &= \sigma_1 (G_{i,t-\tau} - G_{i,t-2\tau}) + \sigma_2 (IS_{i,t} - IS_{i,t-\tau}) + \sigma_3 (ISIS_{i,t} - ISIS_{i,t-\tau}) \\ &+ \sum_{h=1}^{2} \delta_h (W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + (\varepsilon_{i,t} - \varepsilon_{i,t-\tau}) \end{aligned} \quad (2)$$

where, $G_{i,t}$ is GDP growth of country i in period t, σ_0 is a constant, IS entails insurance (life insurance and non-life insurance), $ISIS$ denotes quadratic interactions between insurance indicators ("life insurance" × "life insurance", "non-life insurance" × "non-life insurance"), W is the vector of control variables (mobile phone penetration and political stability), τ represents the coefficient of auto-regression which is one within the framework of this study because a year lag is enough to capture past information, ξ_t is the time-specific constant, η_i is the country-specific effect and $\varepsilon_{i,t}$ the error term.

It is relevant to clarify exclusion restrictions that are important for a robust GMM specification. In accordance with the extant literature, all explanatory variables are acknowledged as predetermined or endogenous explaining. Only the time indicators are considered to exhibit strict exogeneity (Asongu & Nwachukwu, 2016c; Tchamyou & Asongu, 2017; Tchamyou *et al*., 2019; Boateng *et al*., 2018). This estimation approach is also in line with

Roodman (2009b) who has argued that it is unfeasible for years to become endogenous after a first difference[5].

Building on the discussed identification strategy, the exclusion restriction assumption (i.e. categorisation of endogenous explaining and strictly exogenous variables) is assessed with the Difference in Hansen Test (DHT) for instrument exogeneity. This criterion for assessing the validity of the exclusion restriction is consistent with the standard instrumental variable (IV)approach in which, failure to reject the null hypothesis of the over-identifying restrictions test is an indication that the strictly exogenous variables do not explain the outcome variable beyond the proposed mechanisms (Beck *et al*., 2003; Asongu & Nwachukwu, 2016d). Hence, in order for the exclusion restriction assumption to hold, the null hypothesis of the DHT should not be rejected in the results that are disclosed in the next section.

4. Empirical results

4.1 Presentation of results

This section presents the empirical results in Table 1. The left-hand side of the table focuses on life insurance whereas the right-hand side is concerned with non-life insurance. Each of the specifications on the insurance dynamics has a primary estimation and a secondary estimation. The primary estimation which is non-quadratic focuses on the direct effect of insurance on economic growth whereas the secondary estimation which is interactive and/or quadratic assesses the relevance of enhancing insurance on economic growth. For all estimations, four information criteria are employed to assess the validity of the GMM model with forward orthogonal deviations[6]. In the light of the information criteria, all estimated models are valid.

In order to assess the overall relevance of enhancing insurance in economic growth, net effects from the unconditional and marginal or conditional impacts of insurance penetration are computed. For instance in the third column of Table 1, the net impact from increasing life insurance is -1.418 (2×[0.217× 0.881] + [-1.801]). In the computation, the mean value of life insurance is0.881, the unconditional effect of life insurance is -1.801 while the conditional effect

[5]Hence, the procedure for treating *ivstyle* (years) is 'iv (years, eq(diff))' whereas the *gmmstyle* is employed for predetermined variables.

[6] "*First, the null hypothesis of the second-order Arellano and Bond autocorrelation test (AR (2)) in difference for the absence of autocorrelation in the residuals should not be rejected. Second the Sargan and Hansen over-identification restrictions (OIR) tests should not be significant because their null hypotheses are the positions that instruments are valid or not correlated with the error terms. In essence, while the Sargan OIR test is not robust but not weakened by instruments, the Hansen OIR is robust but weakened by instruments. In order to restrict identification or limit the proliferation of instruments, we have ensured that instruments are lower than the number of cross-sections in most specifications. Third, the Difference in Hansen Test (DHT) for exogeneity of instruments is also employed to assess the validity of results from the Hansen OIR test. Fourth, a Fisher test for the joint validity of estimated coefficients is also provided*" (Asongu & De Moor, 2017, p.200).

from enhancing life insurance is 0.217. In the fifth column of the same table, the net impact from increasing non-life insurance is -3.673 (2×[1.822× 0.798] + [-6.581). In the computation, the mean value of non-life insurance is 0.798, the unconditional effect of non-life insurance is -6.581 while the conditional effect from enhancing non-life insurance is 1.822.The computation is consistent with contemporary literature on interactive regressions (Tchamyou, 2019b; Agoba *et al*., 2019).

Table 1: Insurance and Growth

	Dependent variable: GDP growth			
Constant	**3.749*** **	**5.392*** **	**4.407*** **	**8.177*** **
	(0.005)	**(0.000)**	**(0.005)**	**(0.000)**
GDP growth (-1)	**0.366*** **	**0.267*** **	**0.331*** **	**0.260*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.001)**
Life Insurance (LI)	**1.149*** **	**-1.801*** **	---	---
	(0.001)	**(0.000)**		
Life Insurance (LI)×Life Insurance (LI)	---	**0.217*** **	---	---
		(0.000)		
Non Life Insurance (NLI)	---	---	0.438	**-6.581** **
			(0.690)	**(0.032)**
NLI×NLI	---	---	---	**1.822* **
				(0.050)
Mobile phone penetration	**-0.031*** **	-0.011	**-0.015* **	-0.005
	(0.002)	(0.136)	**(0.061)**	(0.559)
Political Stability	0.421	**1.704*** **	0.605	0.781
	(0.594)	**(0.008)**	(0.418)	(0.370)
Time Effects	Yes	Yes	Yes	Yes
Net Effects	na	-1.418	na	-3.673
AR(1)	(0.000)	(0.002)	(0.001)	(0.001)
AR(2)	**(0.561)**	**(0.595)**	**(0.660)**	**(0.804)**
Sargan OIR	(0.020)	(0.025)	(0.002)	(0.014)
Hansen OIR	**(0.155)**	**(0.360)**	**(0.492)**	**(0.479)**
DHT for instruments				
(a)Instruments in levels				
H excluding group	**(0.847)**	**(0.864)**	**(0.707)**	**(0.438)**
Dif(null, H=exogenous)	(0.045)	**(0.144)**	**(0.312)**	**(0.463)**
(b) IV (years, eq(diff))				
H excluding group	(0.092)	**(0.112)**	**(0.415)**	**(0.133)**
Dif(null, H=exogenous)	**(0.367)**	**(0.792)**	**(0.490)**	**(0.898)**
Fisher	**14.99*** **	**553.23*** **	**7.96*** **	**7.53*** **
Instruments	28	32	28	32
Countries	37	37	38	38
Observations	310	310	328	328

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests. The mean of Life Insurance is 0.881 and the mean of Non Life Insurance is 0.798.na: not applicable because the specification is not quadratic.

The following findings can be established. Life insurance increases economic growth while the effect of non-life insurance is not significant. Increasing both life insurance and non-

life insurance has negative net effects on economic growth. The significant control variables have the expected signs.

4.2 Extended analysis with policy thresholds

In the light of the motivation of the study, the analysis is extended to establish thresholds at which increasing insurance is relevant for economic growth. Accordingly, whereas the net effects are consistently negative on economic growth, the corresponding marginal or conditional impacts used to compute the net impacts are consistently positive. An implication of this tendency is that an increasing marginal effect on economic growth is apparent and by extension, it is feasible that at a certain critical mass, the net negative effect on economic growth is completed nullified, such that an increase in insurance penetration beyond the threshold has a positive effect on economic growth. Hence, at the established threshold the net effect of increasing insurance on economic growth is zero.

It is also relevant to clarify that in order for the established thresholds to be relevant to policy makers and make economic sense, they should be within the statistical range disclosed by the summary statistics, notably: the corresponding minimum and maximum values. The definition and conception of critical mass or threshold are in accordance with the extant threshold literature, notably: minimum conditions for anticipated effects (Cummins, 2000); requirements for U-shaped and Kuznets patterns (Ashraf & Galor, 2013); critical masses for desired macroeconomic outcomes (Roller & Waverman, 2001; Batuo, 2015) and thresholds at which increasing carbon dioxide emissions negatively affect inclusive development (Asongu, 2018).

In the light of the above clarification, the positive threshold of life insurance is 4.149 (1.801/ [2×0.217]). Hence, 4.149 of life insurance premium (% of GDP) is the minimum value required for life insurance to positively affect economic prosperity in the sampled countries. This threshold makes economic sense and has policy relevance because it is within the maximum limit of 12.220 % of life insurance imposed by the summary statistics. Furthermore, the positive threshold of non-life insurance is 1.805 (6.581/ [2×1.822]). Hence, 1.805 of non-life insurance premium (% of GDP) is the minimum value required for non-life insurance to positively affect economic prosperity in sampled countries. This threshold also makes economic sense and has

policy relevance because it is within the maximum limit of 2.774% of non-life insurance imposed by the summary statistics.

4.3 Further robustness check using a non-linear estimation technique

A critique to the underlying estimation technique could be that, non-linear estimation techniques are more appropriate for estimating thresholds. With regards to panel data, to the best of our knowledge, the documented non-linear techniques are more convenient for balanced data structures (Wang, 2015). Hence, in order to apply the Hansen (1999, 2000) Panel Threshold Regression (PTR) technique, the unbalanced sampled of 48 countries is reduced to 28 countries which, exhibit a balanced panel dataset.

The 28 retained countries are: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Côte d'Ivoire, Egypt, Gabon, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Seychelles, South Africa, Tanzania, Togo, Tunisia and Uganda. The 20 excluded countries are: Cabo Verde, Chad, Comoros, Congo Democratic Republic, Congo Republic, Djibouti, Ethiopia, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, Mauritania, Rwanda, Sao Tome & Principe, Senegal, Sierra Leone, Sudan, Swaziland, and Zambia.

Following specification insights from Wang (2015)[7], the GMM regressions are replicated within the framework of the underlying PTR modelling to obtain thresholds of 2.998% (2.730 % lower limit and 3.221% upper limit) for life insurance and 1.504% (1.484 % lower limit and 1.518 % upper limit) for non-life insurance. It is important to note that the thresholds found using the interactive GMM technique are 4.149 % for life insurance and 1.805 % of non-life insurance. However, the findings based from the GMM technique are more representative of Africa and also more consistent with the graphical insights provided in Section 2.1.

5. Concluding remarks and future research directions

This study investigates the role of insurance on economic growth by focusing on a panel of forty-eight countries in Africa for the period 2004-2014. The empirical evidence is based on

[7] In the light of Wang (2015), in the specification of the PTR: the number of thresholds is 1 (i.e. thnum (1)); the default number of grid points of 300 is used (i.e. grid (300)); the default number of trimming proportions is used (i.e. trim (0.01)) and 300 bootstrap replications are involved (i.e. bs(300)).

Generalized Method of Moments. The following findings are established. Life insurance increases economic growth while the effect of non-life insurance is not significant. Increasing both life insurance and non-life insurance has negative net effects on economic growth.The analysis is extended to established policy thresholds at which enhancing insurance penetration crowds-out the unconditional negative effect of insurance on economic growth. From the extended analytical exercise, 4.149 of life insurance premium (% of GDP) is the minimum critical mass required for life insurance to positively affect economic prosperity while 1.805 of non-life insurance premium (% of GDP) is the minimum threshold required for non-life insurance to positively affect economic prosperity in the sampled countries.These thresholds have policy relevance and make economic sense because they are within the acceptable economic ranges of life and non-life insurance premiums.

28 of the sampled 48 countries exhibit a balanced panel dataset. Hence, the research uses the Panel Threshold Regression technique of Hansen (1999) and finds thresholds of 2.998% for life insurance and 1.504% for non-life insurance. It is important to note that the thresholds found using the interactive GMM technique are 4.149 % for life insurance and 1.805 % of non-life insurance. However, the findings based from the GMM technique are more representative of Africa and also more consistent with the graphical insights provided in Section 2.1.

In what follows, the research further discusses the policy implications of the established thresholds in the light of development challenges in Africa. Accordingly, further discussion of policy implications should align with the computed thresholds and focus on how insurance penetration in Africa can be promoted to reach the critical masses found in this research. Accordingly, as supported by De Montchalin and Wattez-Richard (2017), insurance directly contributes to economic development on the continent of Africa because it drives economic growth by *inter alia*, acting: (i) as a vector for solidarity and distribution between people and (ii) as a stabilizer for households and businesses confronted with random shocks. However, for the suggested economic growth benefits to be achieved, the insurance levels should reach established thresholds. Moreover with these critical masses: (i) awareness of advantages associated with the insurance markets and (ii) new mechanisms for the promotion of insurance penetration have to be taken on board by policy-making bodies. These measures on increasing insurance penetration are critically discussed in turn.

First, the concern of awareness is particularly important because despite developing products and services of the standards of developed countries, total insurance premiums in Africa are still on average situated around 1% of GDP, compared to 9% in France and 5% in Asia (Montchalin & Wattez-Richard, 2017). Accordingly, insurance commodities have not been efficiently tailored to African needs and realities because such insurance operations have been built on complex and long contracts as well as distributed via networks of brokers and agents that are very costly on the one hand and, on the other, largely restricted to the urban elite and areas. This research has highlighted the comparative penetration rates in Asia and France in order to clearly articulate that efforts are needed to increase insurance penetration from the average 1% in Africa to the average levels in Asia that are consistent with the insurance thresholds established in this research as fundamental to boosting economic growth.

In the light of the above, insurers should take on board policies that are designed to target the high proportion of the African population that is mainly located in rural areas, dependent on traditional insurance schemes and unaware of the benefits of formal insurance schemes. For instance, the assumption that the poor in urban areas and a majority of the population located in rural areas are uninsurable is void of the fundamental essence of insurance – because the poor are the most vulnerable to concerns needing insurance schemes. Developing these insurance policies that target the urban poor and the rural population requires a sound knowledge of the fact that traditional risk management mechanisms are still deeply entrenched in African societies. For instance: (i) couples have many children with the objective that in their old age, they would be taken care of and (ii) precautionary savings are held in terms of equipment that can quickly be sold when the need arises. It follows then that insurers need to tailor their sensitization and awareness plans and policies such that the purported advantages of formal insurance schemes outweigh traditional and informal insurance mechanisms both in terms of cost and benefits.

Second, insurers can also leverage on new technologies to increase awareness and address failures of traditional insurance markets; notably, the reinvention of insurance business models on the premise of three main challenges: the difficulty of access, lack of trust partly due to complexity and price. Digitally-enabled schemes can be tailored to reduce transaction costs and ensure more trust. In essence, digital leapfrogging in the insurance sector has the potential to provide huge opportunities for the previously neglected fractions of society. Like mobile banking which has been tailored to provide access to finance to the previously unbanked elements of

society throughout Africa (e.g. M-PESA in Kenya), digital leapfrogging can enable insurers to bundle insurance commodities with other services of added value such as health solutions and financial education. Some examples of insurance related schemes already being applied in the area of mobile health in some countries in Africa include: (i) AXA in Egypt which offers its customers access to medical doctors via telephone consultations; (ii) the Foyo mobile application in Rwanda which is providing users with information and advice on health issues at the price of a short message service (i.e. SMS); and (iii) Mamakiba that is helping pregnant women of low-income status to save in anticipation for needs pertaining to maternal health.

Third, governments of sampled countries can encourage awareness schemes and the penetration of information technology relevant to enhancing insurance penetration in the contemporary era, by working with insurers towards projects of reducing information asymmetry associated with modern insurance schemes. For instance, government-led information technology policies designed to increase wide access to information and communication technology can facilitate the discussed insurers' policy projects of: (i) increasing awareness and (ii) leveraging on new technologies to boost insurance penetration.

Future studies should use alternative estimation frameworks to assess whether the findings withstand empirical scrutiny in country-specific settings. The recommendation is based on the caveat that country-specific effects are inherently eliminated in GMM modelling in order to control for endogeneity. The recommended country-specific analyses are worthwhile for more targeted and country-oriented implications. Moreover, owing to the unbalanced nature of the dataset used in this study, alternative estimation approaches that specifically focus on nonlinear regressions are inappropriate to be used, notably the Panel Threshold Regression (PTR) method of Hansen (1999) and the Panel Smooth Transition Regression (PSTR) by González et al. (2005) and recently improved by González et al. (2017). These alternative models should be explored within the framework of balanced datasets in future studies.

Conflict of interest statement

The authors have no conflict of interest.

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Appendices

Appendix 1: Definitions of Variables

Variables	Signs	Definitions of variables (Measurements)	Sources
Economic growth	GDPg	Gross Domestic Product growth (annual %)	WDI
Insurance	LifeIns	Life Insurance Premium Volume to GDP (%)	FDSD
	NonLifeIns	Non-life Insurance Premium Volume to GDP (%)	FDSD
Mobile Phones	Mobile	Mobile cellular subscriptions (per 100 people)	WDI
Political Stability	PolS	"Political stability/no violence (estimate): measured as the perceptions of the likelihood that the government will be destabilised or overthrown by unconstitutional and violent means, including domestic violence and terrorism"	WDI

WDI: World Bank Development Indicators of the World Bank. FDSD: Financial Development and Structure Database of the World Bank.

Appendix 2: Summary statistics (2004-2014)

	Mean	SD	Minimum	Maximum	Observations
GDP growth	5.186	4.392	-36.699	33.735	462
Life Insurance	0.881	2.126	0.0006	12.220	346
Non Life Insurance	0.798	0.536	0.005	2.774	367
Mobile Phone Penetration	45.330	37.282	0.209	171.375	558
Political Stability	-0.471	0.905	-2.687	1.182	462

S.D: Standard Deviation.

Appendix 3: Correlation matrix

GDPg	LifeIns	NonLifeIns	Mobile	PolS	
1.000	0.055	0.032	-0.187	0.051	GDPg
	1.000	0.726	0.095	0.248	LifeIns
		1.000	0.158	0.379	NonLifeIns
			1.000	0.243	Mobile

	1.000	PolS

GDPg: GDP growth. LifeIns: Life Insurance. NonLifeIns: Non Life Insurance.
Mobile: Mobile Phone Penetration. PolS: Political Stability.