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# The Moderating Role of Innovation on Institutional Components and Life Insurance Penetration: Evidence from Sub-Saharan Africa

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## Abstract

A well-functioning insurance market benefits the economy by promoting efficient capital allocation, liquidity, savings, and risk reduction. However, in most Sub-Saharan African (SSA) countries, risk protection uptake is sketchy compared to other regions. For instance, data shows that insurance penetration in Africa stood at 2.78% in 2019, lower than the global average of 7.23%. Hence, this study aims to determine the moderating effect of innovation on institutional components and life insurance penetration in 35 SSA nations between 2009 and 2020. The study employs data from the Financial Development and Structure Database (FDSD), Worldwide Governance Indicators (WGI), and World Intellectual Property Organization (WIPO) for life insurance penetration, the institutional components, and the global innovation index. The study uses the panel corrected standard errors (PCSEs) estimation technique. The study establishes that innovation promotes life insurance penetration by enhancing voice and accountability, the rule of law, and government efficacy mechanisms. The study concludes that innovation is an essential catalyst for performance efficiency through which weak institutional factors can be improved to stimulate insurance uptake. This study adds to the scant body of knowledge on insurance advancement in Africa by examining the previously underexplored function of innovation via the pathway of institutional components. The findings may assist policymakers, managers, and other stakeholders in coordinating innovation plans with institutional mechanisms to boost insurance coverage in the SSA region.

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## 1. Introduction

Financial inclusion seeks to improve access to valuable financial services or products to meet the needs of individuals and businesses. One financial service that contributes to financial inclusion is insurance penetration in society. Insurance penetration indicates the pervasiveness of insurance products in the market. Effective capital allocation, liquidity availability, financial planning, and risk mitigation are essential aspects of insurance market development (Lee, Cheng, Chong, & Sia, 2018; Salleh et al., 2020). In essence, parties who are insured are less vulnerable to catastrophes. Sha'aban and Salleh (2021) argued that without insurance cover, catastrophes increased the financial fragility of individuals and businesses, requiring them to resort to sales of assets, out-of-pocket spending, and credit to deal with the financial load. Despite the importance of insurance and the need for its penetration in society, in most Sub-Saharan Africa (SSA) countries, risk protection uptake is sketchy compared to other regions. Data on insurance shows disparities among the global regions regarding insurance development. For instance, penetration in Africa stood at 2.78% in 2019, considerably lower than the global average of 7.23% and, notably, the lowest globally (Swiss, 2020). These

inequalities require further investigation to determine the factors militating life insurance development in the SSA region. Chikalipah (2017) study had a similar focus; the author reported that the SSA region had the lowest participation rate in financial activities. Low insurance penetration limits the ability of countries in the SSA region to manage risk effectively during a disaster. Hence, there is a need to determine which factors drive financial services accessibility and growth from the perspective of life insurance.

Previous studies on factors driving access to financial services and growth have mainly focused on the banking industry, with only a handful examining the insurance industry, revealing a significant gap in the literature (Ben Dhiab & Dkhili, 2022). Most of these studies confirmed that the growth of the life insurance industry was strongly related to financial, social, and economic factors (e.g., (Guellil & Benhabib, 2022; Hwang & Gao, 2003; Li, Moshirian, Nguyen, & Wee, 2007; Outreville, 1996; Truett & Truett, 1990)). According to a large body of literature, sound institutional quality offers an enabling environment for economic, political, social, and cultural development, whilst bad institutions, on the other hand, obstruct development (Fomba, Talla, & Ningaye, 2022; Hafiz, Salleh, & Garba, 2021; Nasir & Redmond, 2020; Zámborský, Yan, Sbaï, & Larsen, 2021). Fomba et al. (2022) pointed out that most countries in the SSA region are characterized by weak institutions. However, Burhan, Razak, Salleh, and Tovar (2017) argued that innovation capability influences the quality of institutions associated with the business environment. Su, Cai, and Huang (2022) added that this innovative capability fully supports the efficient use of existing resources to exploit opportunities in the current institutional environment.

This study examines the moderating effect of innovation capability on the relationship between institutional components and life insurance penetration in SSA countries. This paper argues that innovation can be contingent on the relationship between institutional components and life insurance penetration. Recent literature has shown that interactive regressions provide findings with more policy relevance (Asongu, Le Roux, & Biekpe, 2018; Tchamyou, 2018). Institutional components generally reflect country-specific institutional traits derived from economic, political, and social systems (Dragos, Mare, & Dragos, 2019). Bradley, Kim, Klein, McMullen, and Wennberg (2021) asserted that institutions are critical to financial service development because the growth process requires norms, rules, and standards of conduct to govern transactions among economic agents. In this study, the innovation capability is represented by the global innovation index (GII), which is based on the average of innovation inputs and outputs indices that offers a simplified version of the comprehensive innovation performance of a country as computed by the World Intellectual Property Organisation (WIPO) on an annual basis. This is consistent with prior studies (Kawabata & Junior, 2020; Văduva, Gherghina, & Duca, 2018). Researchers have employed a variety of proxies such as patent rights, research expenditure, and new product sales that capture only a portion of efforts to operationalize innovation. However, these measures neglect the contributions of local firms' processes, organization, and marketing innovations (Brian, Meadowcroft, & Gallardo, 2019; Salleh et al., 2017). Moreover, some innovative activities cannot be patented or transformed into new products (Su et al., 2022). Therefore, the GII offers a simplified version of the innovation inputs, outputs, and intensity measures to reveal countries' comprehensive innovation performance (Todeva, 2020).

Institutional components are as important to life insurance penetration as economic, demographic, social, and cultural components because sound institutions foster an atmosphere conducive to economic, political, social, and cultural development (Fomba et al., 2022). In a cross-country study of selected emerging nations, Sepehrdoust and Ebrahimnasab (2015) found that political stability positively affected life insurance penetration. This finding is consistent with Ward and Zurbruegg (2002), who studied 25 Organization for Economic Co-operation and Development (OECD) and 22 Asian countries. Their results revealed that per capita income, financial growth, political stability, and the rule of law positively impacted life insurance demand. However, in their respective studies, Dragos, Mare, Dragota, Dragos, and Muresan (2017) and Weedige (2019) found that political stability had an insignificant effect. Theoretical postulation as well as a considerable number of researchers, such as Mohammed and Sanusi (2020); Sanjeewa and Ouyang (2020); Iheonu, Ihedimma, and Onwuanaku (2017); Klime Poposki, Kjosevski, and Stojanovski (2015); Petkovski and Jordan (2014) and Chang and Lee (2012), have demonstrated that the performance of economic activities such as insurance penetration dramatically depends on compelling voice and accountability. In contrast, other studies, including those of (Modugu & Dempere, 2020; Uddin, Chowdhury, Sajib, & Masih, 2020), have acknowledged a negative relationship between voice and accountability and economic activity performance. Moreover, the positive relationship between the rule of law and life insurance penetration has been established in prior studies such as those of Ward and Zurbruegg (2002); Nguyen, Avram, and Skully (2010); Chang and Lee (2012), and Sanjeewa and Ouyang (2020). Iheonu et al. (2017) produced a similar result concerning the performance of economic activities. The rule of law is a measure of the degree to which individuals and businesses trust the legal system and its ability to enforce contracts. However, some strands of literature, for instance, Beck and Webb (2003); Esho, Kirievsky, Ward, and Zurbruegg (2004); Kjosevski (2012); Klime Poposki et al. (2015); Dragos et al. (2019) and Mahaini, Noordin, and Mohamad (2019) have recorded an insignificant relationship between the rule of law and life insurance penetration. Moreover, another critical component of institutions is regulatory quality. The regulatory environment instills customer confidence and offers a safe environment for insurers to operate (Daud et al., 2017). Empirical evidence has documented a significant positive relationship between regulatory quality and life insurance penetration, for example (Chang

& Lee, 2012; Gani & Clemes, 2016; Hussels, Ward, & Zurbruegg, 2005; Kwon, 2013; Ward & Zurbruegg, 2002). On the other hand, Park, Borde, and Choi (2002) reported that the regulatory system had a significant adverse effect on insurance. At the same time, Dragos et al. (2019); Mahaini et al. (2019), and Weedige (2019) found insignificant effects. Government effectiveness could lead to policies that strengthen innovation, which is necessary for inclusive finance (Salleh et al., 2020b; Salleh et al., 2020c) and hence insurance penetration. This finding is consistent with previous studies, such as those of Park and Lemaire (2012); Udah and Ayara (2014); Brokešová, Pastoráková, and Ondruška (2014); Ngwenduna, Hayes, and Angove (2015); Alhassan and Biekpe (2016); Radzeviča, Bulderberga, and Krasnopjorovs (2018); Mahaini et al. (2019) and Dragos et al. (2019). However, it is contrary to the results of Kjosevski and Petkovski (2012) and Poposki and Kjosevski (2013). Furthermore, Beck and Webb (2003) asserted that corrupt practices lead to high insurance policy pricing, limiting affordability. Popova and Podolyakina (2014) added that the level of corruption negates the performance of economic activity. Thus, the finding contradicts the new institutional economics (NIE) theory and literature argued for by Chang and Hao (2017) and Sanjeewa and Ouyang (2020), which established the positive influence of the control of corruption on life insurance penetration. However, the finding documented in this study is similar to the findings of prior studies, such as Dieng and Fall (2017); Dragos et al. (2019); Kjosevski and Petkovski (2012); Nesterova (2008).

The current study mainly uses NIE theory to explain the moderating effect of innovation on the link between institutional components and life insurance penetration. NIE highlights the importance of institutions in coordinating human economic activity (Okwor, 2019). High transaction costs constrain the progress of economic activity. These costs stem from information asymmetry and differences in mental capacity (Obisesan & Olayide, 2021). Scholars such as North (1990) believe that because decisions rely on bounded rationality, people cannot rationally make the right decision in the face of transaction costs (Hafiz et al., 2021). North (1990) asserted that countries with efficient institutions could reduce transaction costs in their markets, translating to higher economic growth. Inefficient practices characterized by insufficient information disclosure, information asymmetries, and high transaction costs could hinder economic growth. Therefore, innovation is a critical catalyst for performance efficiency, allowing weak institutional variables to improve economic performance (Pradhan, Arvin, Hall, & Nair, 2016; Reimsbach, 2020).

The significant effect of institutional components of life insurance penetration has been evidenced in the literature. Nevertheless, the moderating effect of innovation on the relationship between institutional components and life insurance penetration has not yet been explored. Most of the empirical findings in the literature have demonstrated inconsistent results. The relationship between institutional components and life insurance penetration thus remains inconclusive. The research approach in this paper differs from the previous studies in two ways. First, it integrates innovation into the direct relationship between institutional components and life insurance penetration. Secondly, it employs the global innovation index (GII) as a proxy for cross-country innovation capability instead of patent rights or research and development expenditure (Brian et al., 2019). Innovation is a process that aims to improve the efficiency of a traditional operational procedure to satisfy ever-changing consumer demand (Brophy, 2019; Reimsbach, 2020). Thus, innovation capability places a country in a better position to deal with institutional constraints through proactive adaptation to achieve higher performance levels (Su et al., 2022). Institutional components interact with innovation and are expected to significantly impact demand orientation (Ipek & Tanyeri, 2020) because an ability to innovate is one of the most valuable assets for the successful implementation of the overall plan, while political, economic, and institutional aspects provide favorable conditions for financial development (Asongu & Odhiambo, 2019; Rajapathirana & Hui, 2018), such as that of the insurance industry. This article argues that the interaction of innovation and institutional components likely improves insurance penetration.

## 2. Methodology

This study examined the moderating effect of innovation on institutional components and life insurance penetration. Specific macroeconomic indicators were selected as control variables to determine this effect. These included the 'growth domestic product,' inflation depletion rate, life expectancy rate, dependence ratio, citizens' income level, urbanization, and interest rate. Segodi and Sibindi (2022) suggested that macroeconomic factors are essential drivers of insurance development. For instance, Nebolsina (2020) mentioned that an increasing number of dependents, combined with less favorable economic conditions, harm the affordability of insurance policies. However, according to Lim and Tan (2019), the principal aim of life insurance is to safeguard heirs from financial troubles in the event of a breadwinner's early death. Hence, the young-age dependency ratio promotes household demand for commercial insurance in China, while the old-age dependency ratio has an adverse effect (Li, Li, & Lv, 2021).

Furthermore, Kjosevski (2012) argued that demand for life insurance tends to grow as the state economy grows. This study also controlled for Gross Domestic Profit (GDP). Individuals with higher incomes have more purchasing power, making life insurance more affordable. Individuals are more inclined to get life insurance to secure a given level of utility over an indefinite quantity of utility (i.e., to ensure certainty) or to pass assets down to their offspring (Lim & Tan, 2019). For this reason, and consistent with Zerriaa, Amiri, Noubbigh, and Naoui (2017), the income level was controlled. Moreover, this study suggested controlling

interest rate, life expectancy, urbanization, and inflation. Insurance disintermediation is fueled by the disparity between the returns offered by alternative investment vehicles and those supplied by life savings products as policyholders shift their funds to market products that give higher yields (Poufinas & Michaelide, 2018). Thus, higher interest rates are expected to result in low demand for insurance policies. Higher life expectancy harms life insurance demand since it implies reduced chances of death and weaker motivation to buy life insurance. While Outreville (1996) finding indicated a positive link, on the other hand, Li et al. (2007) found a negative relationship. Industrialization leads to urbanization, which increases the population of cities. People living in big cities have more access to various financial services. Financial products become more accessible as income levels rise.

Similarly, a large concentration of the population in one place saves insurers the cost of marketing and policy distribution, resulting in lower insurance pricing. Together, these factors allow the insurance industry to expand, especially in developing markets. Meko, Lemie, and Worku (2019) established a positive relationship between urbanization and life insurance. One benefit of insurance is that it encourages long-term financial and monetary savings. On the contrary, inflation diminishes the purchasing power of savings. People are less likely to buy insurance if uncertain about its benefits (Beck & Webb, 2003; Outreville, 1996).

To investigate the moderating effect of innovation on institutional components and life insurance penetration at a cross-country level, the regression model of Weedige (2019) is adopted as:

$$LIP = \beta_0 + \beta_1 GDP_{it} + \beta_2 ID_{it} + \beta_3 ADR_{it} + \beta_4 LEXP_{it} + \beta_5 INTR_{it} + \beta_6 URB_{it} + \beta_7 INFLD_{it} + \beta j Institutional\ components_{itj} + \varepsilon_{it}$$

Where $\beta_0$ = value of the intercept, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$, $\beta_6$, $\beta_7$, $\beta j$ = coefficients of the explanatory variables, LIP = Life Insurance Penetration, GDP = Growth Domestic Product, ID = Income Distribution, ADR = Age Dependency Ratio, LEXP = Life Expectancy, INTR = Interest Rate, URB = Urbanization Rate, INFLD = Inflation Deflator Rate, Institutional Components denote the six governance indicators (Political Stability, Government Effectiveness, Voice and Accountability, Regulatory Quality, Corruption-Control, and the Rule of Law), i = Number of Countries, j = Number of Institutional Components, t = Time Period, and $\varepsilon$ = Error Term. Weedige (2019) studied the effect of institutional components on insurance consumption with socio-economic factors as control variables. However, to assess the moderating effect of innovation, which is the primary purpose of the present study, we extend the adopted model by including orthogonalized interaction terms (VACGI, ROLGI, REQGI, GEFGI, COCGI, and PTSGI). Thus, six models were specified for each of the institutional components as follows:

$$LIP = \beta_0 + \beta_1 GDP_{it} + \beta_2 ID_{it} + \beta_3 ADR_{it} + \beta_4 LEXP_{it} + \beta_5 INTR_{it} + \beta_6 URB_{it} + \beta_7 INFLD_{it} + \beta_8 GII_{it} + \beta_9 VAC_{it} + \beta_{10} VACGI_{it} + \varepsilon_{it} \quad (1)$$

$$LIP = \beta_0 + \beta_1 GDP_{it} + \beta_2 ID_{it} + \beta_3 ADR_{it} + \beta_4 LEXP_{it} + \beta_5 INTR_{it} + \beta_6 URB_{it} + \beta_7 INFLD_{it} + \beta_8 GII_{it} + \beta_9 ROL_{it} + \beta_{10} ROLGI_{it} + \varepsilon_{it} \quad (2)$$

$$LIP = \beta_0 + \beta_1 GDP_{it} + \beta_2 ID_{it} + \beta_3 ADR_{it} + \beta_4 LEXP_{it} + \beta_5 INTR_{it} + \beta_6 URB_{it} + \beta_7 INFLD_{it} + \beta_8 GII_{it} + \beta_9 REQ_{it} + \beta_{10} REQGI_{it} + \varepsilon_{it} \quad (3)$$

$$LIP = \beta_0 + \beta_1 GDP_{it} + \beta_2 ID_{it} + \beta_3 ADR_{it} + \beta_4 LEXP_{it} + \beta_5 INTR_{it} + \beta_6 URB_{it} + \beta_7 INFLD_{it} + \beta_8 GII_{it} + \beta_9 GE_{it} + \beta_{10} GEFGI_{it} + \varepsilon_{it} \quad (4)$$

$$LIP = \beta_0 + \beta_1 GDP_{it} + \beta_2 ID_{it} + \beta_3 ADR_{it} + \beta_4 LEXP_{it} + \beta_5 INTR_{it} + \beta_6 URB_{it} + \beta_7 INFLD_{it} + \beta_8 GII_{it} + \beta_9 CC_{it} + \beta_{10} COCGI_{it} + \varepsilon_{it} \quad (5)$$

$$LIP = \beta_0 + \beta_1 GDP_{it} + \beta_2 ID_{it} + \beta_3 ADR_{it} + \beta_4 LEXP_{it} + \beta_5 INTR_{it} + \beta_6 URB_{it} + \beta_7 INFLD_{it} + \beta_8 GII_{it} + \beta_9 PS_{it} + \beta_{10} PTSGI_{it} + \varepsilon_{it} \quad (6)$$

Where $\beta_0$ = value of the intercept. $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$, $\beta_6$, $\beta_7$, $\beta j$ = coefficients of the explanatory variables, LIP = Life Insurance Penetration, GDP = Growth Domestic Product, ID = Income Distribution, ADR = Age Dependency Ratio, LEXP = Life Expectancy, INTR = Interest Rate, RB = Urbanization Rate, INFLD = Inflation Deflator Rate, GII = Innovation, VAC = Voice & Accountability, ROL = Rule of Law, RQ = Regulatory Quality, GE = Government Effectiveness, CC = Control of Corruption, PS = Political Stability, VACGI = interaction of VAC and GII, ROLGI = interaction of ROL and GII, REQGI = interaction of RQ and GII, GEFGI = interaction of GE and GII, COCGI = interaction of CC and GII, PTSGI = interaction of PS and GII.

Life insurance penetration is the dependent variable, which denotes the proportional value of life insurance premiums to the domestic growth product i for the period t. These values were obtained from the Financial Development and Structure Database (FDSD) of the World Bank. Institutional components denote the six governance indicators (political stability, government effectiveness, voice and accountability, regulatory quality, corruption-control, and the rule of law). Each of these indicators ranges from the lowest value of -2.5 to the highest value of 2.5. A lower score indicates poor quality of governance, whereas a higher score indicates sound governance. Institutional components data was sourced from the World Bank's World Governance Indicators for country i for period t. Innovation denotes the global innovation index and is the average innovation input and output for a country over a period t, obtained from the World Intellectual Property Organization (WIPO). Interaction terms in the study were created using the orthogonalizing technique to avoid multicollinearity problems (Law, 2019). Orthogonalizing implies estimating the product of

two variables, regressing these variables with the product as the DV, predicting the residual, and maintaining the residual as the interaction term in the regression model. The control variables considered in this paper are GDP, age dependency, income, urbanization, interest rate, inflation depletion rate, and life expectancy. The data for these control variables were obtained from the World Bank's World Development Indicators. Panel data frequently exhibits both contemporaneous correlations across units and heteroskedasticity at the unit level, making inference from standard errors inaccurate in most cases. Thus, the above models are estimated using the panel corrected standard error (PCSE) approach. The approach is used because it produces results devoid of autocorrelation, generates consistent standard error estimates, and is less susceptible to outliers than other methods (Ikpesu, Vincent, & Dakare, 2019; Reed & Webb, 2010). Table 1 presents the summary statistics for the dependent, independent, and moderating variables.

**Table 1.** Descriptive statistics.

| Variable | Mean | Min | Max | Std. Dev. |
|---|---|---|---|---|
| LIP | 0.960 | 0.000 | 11.910 | 2.025 |
| VAC | -0.426 | -1.838 | 0.998 | 0.708 |
| ROL | -0.510 | -1.852 | 0.975 | 0.574 |
| RQ | -0.501 | -2.118 | 1.127 | 0.527 |
| GE | -0.583 | -1.624 | 1.057 | 0.576 |
| CC | -0.504 | -1.531 | 1.236 | 0.651 |
| PS | -0.463 | -2.665 | 1.104 | 0.852 |
| GII | 22.530 | -27.160 | 49.160 | 10.545 |
| EDU | 65.558 | 7.550 | 98.910 | 20.548 |
| GDP | 2541.399 | 212.137 | 18505.700 | 3188.251 |
| ID | 43.596 | 31.500 | 63.400 | 6.883 |
| ADR | 81.088 | 41.293 | 111.939 | 16.214 |
| LEXP | 61.155 | 44.146 | 75.046 | 5.868 |
| INTR | 8.553 | -34.462 | 52.437 | 10.031 |
| INFLD | 6.553 | -18.075 | 95.409 | 10.282 |
| URB | 13.813 | 3.515 | 35.582 | 6.660 |

**Note:** LIP = life insurance penetration, VAC = voice & accountability, ROL = rule of law, RQ = regulatory quality, GE = government effectiveness, CC = control of corruption, PS = political stability, GII = innovation, GDP = growth domestic product, ID = income distribution, ADR = age dependency ratio, LEXP = life expectancy, INTR = interest rate, INFLD = inflation deflator rate, URB = urbanization rate.

## 3. Empirical Results

The mean values for the institutional variables are relatively low because the sample consisted of 35 developing countries from the SSA region, mainly characterized by poor institutional quality. The summary statistics show that life insurance penetration in SSA countries remains at 1 % of gross domestic product with values ranging from a minimum of 0 to a maximum of 11.9 %. Similarly, the descriptive results of the control variables indicate that the GDP had an average of 2541.399, a minimum of 212.137, and a maximum of 18505.700. ID reported an average of 43.596 with a minimum of 31.500 and a maximum of 63.400. Nevertheless, ADR averaged 81.088 with a minimum and maximum of 41.293 and 111.939, respectively. LEXP had an average value of 61.155 years, a minimum of 44.146 years, and a maximum of 75.046 years. The descriptive statistics further show that the average value of INTR was 8.553, the minimum value was -34.462, and the maximum was 52.437. INFLD had -18.075 as its minimum value and 95.409 as its maximum, and URB had 3.515 as its minimum, with a maximum value of 35.582.

Before assessing whether innovation moderated the relationship between institutional components and life insurance penetration, diagnostic tests were carried out. This step was vital because such tests are critical to the validity of the empirical result (Tabachnick & Fidell, 2019).

First, multicollinearity was checked via the correlation matrix and variance inflation factors (VIF). Table 2 presents the correlation matrix of the study variables. The results indicate that institutional components were highly correlated. Tabachnick and Fidell (2019) suggested that a correlation with r = 0.9 signifies a potential multicollinearity problem. However, these variables were put into separate regressions to avoid this multicollinearity problem.

Moreover, the VIFs calculated for the separate models fell within the required threshold of not more than ten and not less than 0. The study applied the Wooldridge test for autocorrelation in panel data to check for autocorrelation. The result in Table 3 indicates the presence of autocorrelation as the p-values of the variables are significant. The threshold requires that the p-value be insignificant. Cross-sectional dependence occurs when the panel cross-sections of "N" observations are no longer drawn independently but interfere with one another's outcomes. A shock may be readily transferred from one country to another. The study used Pesaran (2021) test to determine the probability of cross-sectional dependence.

**Table 2.** Correlation matrix.

| Variables | LIP | VAC | GE | RQ | CC | PS | ROL | GDP | ID | ADR | LEXP | INTR | INFLD | URB | GII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LIP | 1.000 | | | | | | | | | | | | | | |
| VAC | 0.511* | 1.000 | | | | | | | | | | | | | |
| GE | 0.511* | 0.740* | 1.000 | | | | | | | | | | | | |
| RQ | 0.495* | 0.752* | 0.854* | 1.000 | | | | | | | | | | | |
| CC | 0.433* | 0.704* | 0.886* | 0.763* | 1.000 | | | | | | | | | | |
| PS | 0.439* | 0.649* | 0.716* | 0.635* | 0.736* | 1.000 | | | | | | | | | |
| ROL | 0.494* | 0.784* | 0.612* | 0.870* | 0.893* | 0.752* | 1.000 | | | | | | | | |
| GDP | 0.310* | 0.388* | 0.602* | 0.456* | 0.515* | 0.533* | 0.527* | 1.000 | | | | | | | |
| ID | 0.466* | 0.213* | 0.275* | 0.225* | 0.198* | 0.409* | 0.187* | 0.112* | 1.000 | | | | | | |
| ADR | -0.551* | -0.523* | -0.690* | -0.538* | -0.679* | -0.584* | -0.662* | -0.736* | -0.209* | 1.000 | | | | | |
| LEXP | 0.024 | 0.369* | 0.528* | 0.423* | 0.472* | 0.378* | 0.533* | 0.456* | -0.133* | -0.514* | 1.000 | | | | |
| INTR | -0.178* | -0.102* | -0.111* | -0.069 | -0.083* | 0.035 | -0.070 | -0.085* | -0.085* | -0.012 | 0.196 | 1.000 | | | |
| INFLD | -0.064 | -0.162* | -0.137* | -0.217* | -0.169* | -0.169* | -0.136* | -0.121* | -0.030 | 0.083* | -0.077 | -0.236* | 1.000 | | |
| URB | 0.335* | 0.246* | 0.130* | 0.102* | 0.070 | 0.105* | 0.005 | 0.225* | 0.295* | -0.278* | 0.076 | -0.219* | -0.046 | 1.000 | |
| GII | 0.166* | 0.233* | 0.351* | 0.255* | 0.285* | 0.197* | 0.301* | 0.411* | 0.006 | -0.383* | 0.442* | -0.018 | -0.112* | 0.135* | 1.000 |

**Note:** * indicates significance at 5%.

**Table 3.** Wooldridge test for autocorrelation in panel data.

| Variable | Life insurance | | |
|---|---|---|---|
| | F(1, 34) | Prob> Chi2 | Null (H0) |
| VAC | 78.15 | 0.0000 | Rejected |
| ROL | 76.91 | 0.0000 | Rejected |
| RQ | 76.54 | 0.0000 | Rejected |
| GE | 77.54 | 0.0000 | Rejected |
| CC | 80.85 | 0.0000 | Rejected |
| PS | 76.69 | 0.0000 | Rejected |

**Table 4**. Pesaran cross-sectional dependency test

| Variable | Life insurance | |
|---|---|---|
| | Prob> Chi2 | Absolute Value of Diagonal |
| VAC | 0.0037 | 0.456 |
| ROL | 0.0023 | 0.455 |
| RQ | 0.0022 | 0.454 |
| GE | 0.0399 | 0.451 |
| CC | 0.0016 | 0.452 |
| PS | 0.0006 | 0.445 |

**Table 5**. Hausman specification test

| Variable | Life insurance | | |
|---|---|---|---|
| | Chi2(1) | Prob> Chi2 | Null (H0) |
| VAC | 38.50 | 0.0000 | FEM |
| ROL | 30.60 | 0.0007 | FEM |
| RQ | 31.30 | 0.0005 | FEM |
| GE | 71.15 | 0.0000 | FEM |
| CC | 55.79 | 0.0000 | FEM |
| PS | 29.47 | 0.0100 | FEM |

**Table 6**. Modified Wald test for groupwise heteroskedasticity

| Variable | Life insurance | | |
|---|---|---|---|
| | Chi2 | Prob>Chi2 | Null(H0) |
| VAC | 50621.87 | 0.0000 | Rejected |
| ROL | 30438.89 | 0.0000 | Rejected |
| RQ | 32921.89 | 0.0000 | Rejected |
| GE | 63931.68 | 0.0000 | Rejected |
| CC | 35672.11 | 0.0000 | Rejected |
| PS | 34859.80 | 0.0000 | Rejected |

The results in Table 4 indicate the presence of cross-sectional dependence with a probability value of less than 5%. The Hausman test was used to determine whether fixed effects (FE) or random effects (RE) would yield a more consistent estimate for the dataset. The decision rule states that if the P-value is greater than 5%, RE is the most consistent estimator; otherwise, FE. As shown in Table 5, the fixed effect was considered the most appropriate estimator since all the p-values are less than the 5% significant level. However, Table 6 indicates the presence of heteroscedasticity with p-values of less than 0.05. We could not use FE models to avoid getting bad results because of how these models are estimated (heteroskedasticity, autocorrelation, and cross-section dependence).

## 4. Discussion

This study aimed to examine the moderating effect of innovation on the relationship between institutional components and life insurance penetration in the SSA countries. As presented in Table 5, the fixed effect models emerged as the most appropriate estimation models for all the variables in the Hausman test. However, the presence of autocorrelation, cross-sectional dependency, and heteroskedasticity revealed by the diagnosis tests invalidated the application of FE models due to the apparent bias in the estimation. Therefore, the models' regression coefficients were generated according to the panel corrected standard errors (PCSE) technique. Table 7 provides detailed information about each model, including their regression coefficients and statistics. The PCSE regression results suggest that voice and accountability (VAC), the rule of law (ROL), regulatory quality (RQ), and government effectiveness (GE) have positive and statistically significant effects on life insurance penetration at (ß 0.3521, P<0.01), (ß 0.4705, P<0.01), (ß 0.5537, P<0.01), and (ß 0.4652,

P<0.01, respectively. On the other hand, corruption control (CC) and political stability (PS) had no statistical impact on life insurance penetration.

**Table 7.** Findings of innovation, institutional components, and life insurance penetration.

| LIP | (1) PCSE | (2) PCSE | (3) PCSE | (4) PCSE | (5) PCSE | (6) PCSE |
|---|---|---|---|---|---|---|
| VAC | 0.3521 (0.1250)*** | | | | | |
| ROL | | 0.4705 (0.1556)*** | | | | |
| REQ | | | 0.5537 (0.1684)*** | | | |
| GE | | | | 0.4652 (0.1311)*** | | |
| CC | | | | | -0.0141 (0.1228) | |
| PS | | | | | | 0.0623 (0.0816) |
| GII | 0.0023 (0.0013) | 0.0024 (0.0015) | 0.00167 (0.0014) | 0.0014 (0.0015) | 0.0010 (0.0015) | 0.0003 (0.0015) |
| VACGI | 0.0024 (0.0011)** | | | | | |
| ROLGI | | 0.0045 (0.0020)** | | | | |
| REQGI | | | 0.0013 (0.0019) | | | |
| GEFGI | | | | 0.0054 (0.0022)** | | |
| COCGI | | | | | 0.0052 (0.0021)** | |
| PTSGI | | | | | | 0.0024 (0.0015) |
| GDP | 0.0683 (0.0337)** | 0.0768 (0.0319)** | 0.0830 (0.0335)** | 0.0825 (0.0325)** | 0.0612 (0.0312)** | 0.0757 (0.0308)** |
| ID | 1.7350 (0.5218)** | 1.8057 (0.5107)*** | 1.7106 (0.5164)*** | 1.6624 (0.5077)*** | 1.8262 (0.5442)*** | 2.0333 (0.5106)*** |
| ADR | -0.0667 (0.0083)*** | -0.0654 (0.0070)*** | -0.0681 (0.0073)*** | -0.0657 (0.0071)*** | -0.0728 (0.0077)*** | -0.0742 (0.0065)*** |
| LEXP | -3.7517 (1.1560)*** | -4.0586 (1.1301)*** | -3.8965 (1.1856)*** | -3.8545 (1.1235)*** | -3.4958 (1.0654)*** | -3.7702 (1.0066)*** |
| INTR | -0.0056 (0.0035) | -0.0081 (0.0039)** | -0.0069 (0.0039)* | -0.0083 (0.0037)** | -0.0087 (0.0038)** | -0.0090 (0.0038)** |
| URB | -0.0102 (0.0099) | -0.0008 (0.0093) | -0.0046 (0.0096) | -0.0026 (0.0095) | -0.0052 (0.0091) | -0.0085 (0.0087) |
| INFLD | -0.0031 (0.0027) | -0.0053 (0.0030)* | -0.0040 (0.0029) | -0.0053 (0.0029)* | -0.0057 (0.0031)* | -0.0054 (0.0031)* |
| _CON | 13.3561 (5.3718)** | 14.1989 (5.2355)*** | 14.2425 (5.5500)** | 13.8820 (5.2704)*** | 12.1244 (5.1167)** | 12.8196 (4.8409)*** |
| Net effects of GII | 0.4062 | 0.5719 | n/a | 0.5869 | n/a | n/a |
| R-Square | 0.3599 | 0.3875 | 0.3859 | 0.3861 | 0.3689 | 0.3955 |
| Wald chi2 | 274.530 | 274.53 | 237.74 | 268.76 | 236.05 | 306.35 |
| Prob > chi2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Note:** LIP = life insurance penetration, VAC = voice & accountability, ROL = rule of law, RQ = regulatory quality, GE = government effectiveness, CC = control of corruption, PS = political stability, GII = innovation, VACGI = interaction of VAC and GII, ROLGI = interaction of ROL and GII, REQGI = interaction of RQ and GII, GEFGI = interaction of GE and GII, COCGI = interaction of CC and GII, PTSGI = interaction of PS and GII, GDP = growth domestic product, ID = income distribution, ADR = age dependency ratio, LEXP = life expectancy, INTR = interest rate, URB = urbanization rate, INFLD = inflation deflator rate. Coefficients (Panel corrected standard errors).* p <0.1, ** p <0.05, *** p <0.01.

Evidence from the moderation results revealed that the coefficient of the interaction term VACGI was positive and statistically significant with LIP at (ß 0.0024, P<0.05). ROLGI had a significant positive effect on LIP (ß 0.0045, P<0.05). Furthermore, GEFGI and COCGI had positive and significant effects on life insurance penetration (LIP) with coefficients and p-values of (ß 0.0052, P<0.01) and (ß 0.0054, P<0.01), respectively. However, the interaction effects of REQGI and PSGI were found to be positive and statistically insignificant

at (0.0013, P>0.1) and (0.0024, P>0.05). To ascertain the overall moderating influence of innovation on the relationship between institutional components and life insurance penetration, the results are expressed in terms of net effects, consistent with the previous research on moderation (Agoba, Abor, Osei, & Sa-Aadu, 2020; Asongu, Nnanna, & Acha-Anyi, 2019).

According to Asongu, Nnanna, and Acha-Anyi (2020), the predicted coefficients of the unconditional and conditional effects must be significant to estimate the net effect. The results in Table 7 showed that innovation greatly complemented the rule of law, voice and accountability, and government efficacy, with net effects of 0.5719, 0.4062, and 0.5869, respectively, on life insurance penetration in the SSA region. The study found that innovation is an effective way to strengthen weak voice and accountability, government efficacy, and the rule of law to increase life insurance penetration. This supports the notion that innovation can circumvent weak institutions and help the economy move forward (Hernández, Nieto, & Rodríguez, 2022; Su et al., 2022), in this case, in the area of insurance penetration.

Finally, the results show that growth domestic product (GDP) was positive and significant in all columns (1) to (6). Income distribution (ID) was positive and significant in four (4) out of the six (6) columns. This means that GDP and ID increase the chance of higher life insurance penetration (LIP). On the other hand, the young age dependency ratio (ADR) was negative and statistically significant in columns (1), (2), (3), (5), and (6). At the same time, LEXP was negatively and statistically significantly related to LIP in four (4) of the six (6) columns.

## 5. Conclusion and Future Research Directions

This study aimed to examine the moderating influence of innovation on the effect of institutional components on life insurance penetration in 35 Sub-Saharan African nations between 2009 and 2020. Data from the Financial Development and Structure Database (FDSD), Worldwide Governance Indicators (WGI), and World Intellectual Property Organization (WIPO) were used for empirical estimation of life insurance penetration, institutional components, and the global innovation index. Based on the panel corrected standard errors (PCSEs), it was found that innovation improves life insurance penetration through the mechanisms of improved voice and accountability, government efficacy, and rule of law.

The findings suggest that policymakers should consider that increased life insurance penetration will be an unintended consequence of strengthening institutional components and innovation. The fundamental policy consequence of the results is that governments in the selected countries should strive to devise procedures to improve institutional components and innovation. Increased life insurance penetration is a by-product of improving institutional components and innovation. The insurance business, in turn, could benefit from leveraging innovation since innovation strengthens the political environment by improving information disclosure, contract enforcement, and freedom of expression. Furthermore, they harness innovation aids by creating and executing enabling policies for the provision of public goods and the advancement of the business sector, including the insurance sector. This increases public trust and confidence, which are crucial for insurance development.

Future studies should investigate how this relationship works outside the Sub-Saharan African region using different estimation methods and indicators of innovation, such as the number of scientific and technical journal articles.

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