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Hedging Longevity Risk: The Role of Longevity Bonds and Mortality Derivatives

SAMBO Halimah Sani[1], MUHAMMED Ahmed Yabagi[2], YUSUF, Abdulmalik Abubakar[3] & OTORI, Abdulrahim, Yusuf[4]

[1,2,3,4]**Department of Actuarial Science & Insurance**
Faculty of Management Sciences
Ahmadu Bello University, Zaria-Nigeria

Abstract

This study explores the potential of longevity bonds and mortality derivatives in hedging longevity risk within Nigeria's pension and insurance sectors. As life expectancy in Nigeria gradually increases, the financial risk of extended longevity poses a significant challenge to pension schemes and insurers, potentially undermining their long-term solvency. The study employs time series econometric methods to examine key indicators such as insured life reserves, pension fund liabilities, and life expectancy trends. Data were gathered from the annual financial reports published by PenCom, the CBN, and other relevant regulatory bodies spanning from 2005-2023. The results indicate that while longevity-linked financial instruments are currently absent in the Nigerian market, their introduction could provide an effective solution to mitigate the financial risks associated with longer lifespans. The study highlights the need for regulatory reforms, market development, and capacity-building efforts to enable the successful adoption of longevity bonds and mortality derivatives. The findings underscore the importance of proactive policy interventions to ensure the sustainability of pension funds and insurance systems in the face of Nigeria's evolving demographic profile.

Keywords: Longevity Risk, Longevity Bonds, Mortality Derivatives, Pension Fund, Nigeria Financial Market

1. Introduction

Longevity risk is the financial uncertainty arising from unanticipated increases in life expectancy has emerged as a critical challenge for pension funds, annuity providers, and insurers worldwide. Globally, longevity bonds (securities whose payouts are linked to survivorship rates) and mortality derivatives (such as longevity swaps and q-forwards) have been employed to transfer longevity risk to capital markets. For instance, the issuance of longevity bond by the European Investment Bank in 2004, and the UK's Pension Insurance Corporation's longevity swaps demonstrate how these instruments enhance financial stability (Cairns, 2020).

As global life expectancy continues to rise due to medical advancements, improved healthcare, and better living conditions (United Nations, 2023), Nigeria is also experiencing a gradual but steady increase in its aging population. According to the World Health Organization (WHO, 2023), Nigeria's life expectancy has risen from 53 years in 2000 to 54.8 years in 2025, with projections indicating further increases due to declining mortality rates and better disease management. According to the United Nations and the Nigerian Demographic and Health Survey, Nigeria's life expectancy is 25.5% below the global average. This demographic shift presents significant financial risks, particularly for Nigeria's pension system, which managed over ₦17.35 trillion ($21.5 billion) in assets as of December 2023 (National Pension Commission [PenCom], 2024). However, Nigeria's pension sectors remain heavily reliant on conventional financial and insurance products, reinsurance, and reserve buffers, which may be inadequate in the face of accelerating longevity trends.

The growing longevity risk exposure in Nigeria is exacerbated by the country's defined contribution (DC) pension scheme, which exposes retirees to the risk of outliving their savings. Unlike developed economies with well-established longevity risk transfer mechanisms, Nigeria's financial markets lack structured instruments such as longevity bonds and mortality derivatives, which have been successfully utilised in markets like the UK, Europe, and the US to hedge against unexpected increases in life expectancy (Blake et al., 2021). The absence of these instruments increases the vulnerability of pension funds and insurers to systemic longevity shocks, potentially leading to solvency issues and reduced retirement payouts.

Despite Nigeria's expanding pension industry, with over 10.3 million Retirement Savings Account (RSA) holders as of 2024 (PenCom, 2024), there is limited empirical research on the feasibility of longevity-linked securities in the country. Existing studies have primarily focused on developed markets, leaving a gap in understanding how these instruments could function within Nigeria's emerging financial market structure, characterized by illiquid capital markets, regulatory constraints, and low insurance penetration (only 0.5% of GDP as of 2023, compared to the global average of 7.23%) (Swiss Re, 2023). This study, therefore, aims to examine the effects of longevity bonds and mortality derivatives in Nigeria's insurance market and to propose a structured framework for introducing these management instruments, drawing on global best practices while adapting to Nigeria's unique economic and demographic context.

2.0 Literature Review

2.1 Conceptual Review

Longevity Risk

Longevity risk refers to the financial uncertainty arising from the possibility that individual members of a pension plan, or an annuitant, may live longer than statistically expected, leading to increased financial obligations for pension funds, insurers, and social security systems (OECD, 2023). It is a systematic risk because it affects entire cohorts rather than isolated individuals, making it difficult to diversify using traditional risk management techniques (Blake et al., 2021). In actuarial terms, longevity risk arises when actual survival rates exceed projected mortality rates, leading to higher-than-anticipated payouts for annuities, and pensions, (Pitacco et al., 2023). For example, if Nigerian pension funds assume retirees will live to 75 years based on historical data, but improvements in healthcare extend average lifespans to 85 years, the funds face unfunded liabilities due to prolonged benefit payments (PenCom, 2024).

Life expectancy has steadily increased from around 37.2 years in 1960 to approximately 54.5 years in 2023 reflecting long-term survival gains driven by improved healthcare access and socio-economic developments. Meanwhile, the crude death rate has been falling in recent years: from 11.95 per 1,000 in 2022 to 10.67 per 1,000 in 2025. Longevity risk manifests in two primary forms:

a) Individual Longevity Risk: The risk that a single person outlives their savings or annuity coverage, leading to financial insecurity in old age (WHO, 2023).
b) Aggregate Longevity Risk: The systemic risk faced by institutions (e.g., pension funds, insurers) when an entire population lives longer than predicted, straining financial reserves (Swiss Re, 2023).

Several factors contribute to increasing longevity risk in Nigeria:

a) Rising Life Expectancy: Nigeria's life expectancy has increased from 53 years (2000) to 54.8 years (2025) due to better healthcare and disease control.
b) Declining Fertility Rates: The fertility rate has dropped from 6.0 (1990) to 4.6 (2023), leading to an ageing population (World Bank, 2023).
c) Pension System Vulnerabilities: Nigeria's Defined Contribution (DC) pension system shifts longevity risk to retirees, unlike Defined Benefit (DB) systems where sponsors bear the risk (PenCom, 2024).
d) Inadequate Risk Transfer Mechanisms: Unlike advanced markets, Nigeria lacks

longevity swaps, mortality-linked securities, or reinsurance solutions tailored for longevity risk (Feyen et al., 2023).

Mortality Derivatives

Mortality derivatives are financial instruments whose payoffs are linked to mortality or survival rates within a specified population. They function similarly to traditional derivatives (e.g., options, swaps, futures) but are indexed to mortality trends rather than interest rates, equities, or commodities (Cairns et al., 2023). These instruments allow insurers, pension funds, and reinsurers to hedge against unexpected fluctuations in death rates, which can arise from pandemics, medical breakthroughs, or demographic shifts (Blake, 2024). The most common mortality derivatives include Longevity Swaps, a bilateral contract in which one party (e.g., a pension fund) pays fixed payments, while the counterparty (e.g., an insurer or investor) pays floating payments tied to actual mortality rates. q-Forwards refer to a forward contract where settlement is based on the difference between an agreed mortality rate (forward rate, q) and the actual mortality rate at maturity (Dowd et al., 2024). Mortality Catastrophe Bonds (Cat Bonds) transfer extreme mortality risk (e.g., from pandemics like COVID-19) to capital markets. If a trigger event (e.g., mortality rate exceeding 150% of the historical average) occurs, investors lose part or all of their principal (Swiss Re, 2024). Survivor Bonds, that is, Sovereign or corporate bonds with coupon payments that decrease as a reference population’s survivorship increases (IMF, 2023).

2.2 Theoretical Framework

Given the potential financial strain associated with increasing life expectancy, financial instruments such as longevity bonds and mortality derivatives have emerged as viable mechanisms for hedging this risk (Blake et al., 2019). This study is anchored on a blend of financial risk theories and actuarial models that provide a comprehensive framework for understanding longevity risk management in Nigeria.

The Lifecycle Hypothesis, developed by Modigliani and Brumberg (1954), provides a fundamental basis for understanding longevity risk. The theory posits that individuals plan their consumption and savings over their lifetime, accumulating wealth during their working years and decumulating it in retirement. However, uncertainty about life expectancy disrupts these plans, increasing the risk of outliving one's savings. This issue is particularly relevant for pension funds and annuity providers, which are obligated to provide lifelong payouts (Barr, 2021). Longevity bonds and mortality derivatives offer financial instruments to mitigate these risks by aligning payouts with survival probabilities, ensuring sustainable income flows in retirement.

Similarly, the Actuarial Theory of Risk is crucial in assessing and managing longevity risk (Pitacco, 2020). This theory explains how insurers and pension funds use mathematical models to predict life expectancy and mortality rates to price annuities and pension liabilities accurately. Given the increasing life expectancy in Nigeria rising from 51.7 years in 2014 to 54.6 years in 2024 (World Bank, 2024)—the risk of underestimating longevity remains a major challenge. Longevity bonds and mortality derivatives provide market-based solutions that allow institutions to hedge against unexpected increases in life expectancy, ensuring that financial obligations remain sustainable.

Additionally, behavioural finance theory suggests that psychological biases influence financial decision-making (Thaler, 2017). In Nigeria, limited awareness and cultural misconceptions about life insurance and longevity risk often hinder the adoption of risk-hedging strategies. Many individuals underestimate their life expectancy and fail to adequately prepare for retirement, leading to financial insecurity in old age (Ogujiuba & Ohuche, 2020). Longevity bonds and mortality derivatives provide structured mechanisms to mitigate these biases by enabling

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institutional investors to hedge longevity risks systematically.

2.1 Empirical Review

Empirical studies on longevity risk and its mitigation strategies, such as longevity bonds and mortality derivatives, have been conducted across different economies. These studies examine how pension funds, insurers, and governments address the financial implications of increasing life expectancy. While most research focuses on developed financial markets, emerging economies like Nigeria are gradually recognizing the need for sophisticated longevity risk management instruments. Cairns et al. (2020) analyzed the increasing financial burden of longevity risk on global pension systems, finding that many countries face severe funding shortfalls due to underestimating life expectancy. The study used Lee-Carter stochastic mortality models to forecast mortality trends, demonstrating that traditional pension schemes must adopt hedging strategies to remain solvent.

In Nigeria, Ogujiuba and Ohuche (2020) examined the challenges of pension fund sustainability, emphasizing that increasing life expectancy has been underestimated in actuarial assumptions. The authors utilized time-series data on pension fund contributions and benefit payments and found that without adequate longevity risk management, pension schemes could experience long-term solvency issues. The study recommended introducing mortality-linked financial instruments in Nigeria's pension industry.

Longevity bonds are designed to provide payouts based on the survival rates of a defined population, mitigating the risk that pension funds and annuity providers face from increasing life expectancy. Blake et al. (2019) conducted an empirical study on the effectiveness of longevity bonds in the UK market, utilizing a Monte Carlo simulation model to analyze the impact of such bonds on pension fund sustainability. The study found that longevity bonds significantly reduce financial uncertainty and recommended their adoption in emerging markets. Similarly, Deacon and Derry (2021) assessed the performance of longevity bonds in Europe and Asia, using market-based data from structured pension funds. Their findings showed that longevity bonds provided a cost-effective means of hedging longevity risk, but their market adoption remained low due to pricing difficulties and regulatory concerns.

For Nigeria, Oladipo et al. (2023) explored the potential for introducing longevity bonds in the financial sector. The study conducted a survey among pension fund managers and found that while there is awareness of longevity risk, there is a lack of expertise and market infrastructure to issue and trade such bonds. The authors suggested that Nigerian regulatory bodies, such as the National Pension Commission (PenCom), should work with financial institutions to develop longevity-linked securities.

Mortality derivatives, including longevity swaps, forwards, and structured mortality-linked securities, are widely used in developed economies to hedge against unexpected increases in life expectancy. Blake, Cairns, and Dowd (2021) conducted an empirical assessment of mortality swaps in European pension funds, utilizing historical mortality rate data from 1990–2020. Their findings demonstrated that longevity swaps significantly reduced the financial volatility of pension payouts by transferring risk to investors. In a similar study, Coughlan et al. (2020) examined the effectiveness of mortality swaps in the US market. The study used stochastic mortality models to simulate longevity trends and found that mortality derivatives enhanced risk-sharing mechanisms between pension funds and financial institutions. However, regulatory complexities and counterparty risks remained barriers to widespread adoption.

For Nigeria, Adebayo and Adegbite (2022) analyzed the potential of mortality derivatives as a financial innovation in the insurance sector. Their study employed structured interviews with

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insurance executives and found that while mortality derivatives are not yet in use, there is growing interest in integrating them into risk management frameworks. The study recommended regulatory reforms to encourage innovation in Nigeria's insurance sector, facilitating the development of mortality-linked securities. Adetunji and Hassan (2023) conducted a mixed-method study on the barriers to longevity bond adoption in West Africa. Their study combined survey data from 250 financial experts with regulatory analysis and found that lack of financial market depth, inadequate actuarial expertise, and weak regulatory frameworks were major obstacles.

3.0 Methodology

Given the objective of analyzing the dynamics between life expectancy, adoption of longevity risk hedging instruments, and financial performance over time, an Autoregressive Distributed Lag (ARDL) model was employed. These models are appropriate for examining the relationships between multiple time series variables and can capture both short-term and long-term dynamics. The ARDL model was used to examine the dynamic relationships between the dependent and independent variables. The model allows for the analysis of how past values of life expectancy, pension fund liability, insurance payout and reinsurance market size affect the adoption of longevity bonds and mortality derivatives. Data were gathered from the annual financial reports published by PenCom, the CBN, and other relevant regulatory bodies spanning from 2005-2023. The VAR model will be specified as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{P} \beta_1 X_{1t-i} + \sum_{i=1}^{P} \beta_2 X_{2t-i} + \sum_{i=1}^{P} \beta_3 X_{3t-i} + \sum_{i=1}^{P} \beta_4 X_{4t-i} + ei$$

Where:

Yt represents the dependent variables (Financial Impact proxied by insurance liqidity).

$X_{1t-i}, X_{2t-i}, X_{3t-i}, X_{4t-i}$ are the independent variables (Life Expectancy, Pension Fund Liabilities, Insurance Payouts on Life Insurance Policies, Reinsurance Market Size) with lags up to p.

α is the constant term.

β1,β2,β3,β4 are the coefficients to be estimated.

e_t is the error term.

The lag order p will be determined using model selection criteria, such as the Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC).

The ARDL model will be used to analyze the long-term relationship between life expectancy and the adoption of longevity risk hedging instruments. This model is useful when dealing with variables that may have different integration orders (i.e., some may be stationary while others may be integrated of order one, I(1)). The ARDL model will be specified as follows:

$$ILR_t = \alpha_0 + \sum_{i=1}^{P} \beta_1 ILR_{t-i} + \sum_{i=1}^{q} \lambda_2 LEB_{t-i} + \sum_{i=1}^{q} \lambda_3 PEL_{t-i} + \sum_{i=1}^{q} \lambda_4 IPLP_{t-i} + \sum_{i=1}^{q} \lambda_5 RMS_{t-i} + ei$$

Y= Insurance Liquidity Ratio

Proxies for Longevity Bonds

X1= Life Expectancy at Birth (LEB) – A primary indicator of longevity risk in Nigeria. Higher life expectancy increases demand for longevity hedging instruments. Longevity bonds are designed to hedge the risk of people living longer than expected. Life expectancy at birth is a direct measure of longevity trends in a population. An

increase in LEB signals higher survival probabilities, which directly affects the pricing and demand for longevity-linked instruments. If LEB rises, pension funds and annuity providers face extended payout periods, increasing their exposure to longevity risk. Longevity bonds become more relevant as a hedge against this risk.
X2=Pension Fund Liabilities (PFL) – The total financial obligations of pension funds to retirees, indicating exposure to longevity risk. Pension fund liabilities represent the present value of future payments to retirees. These liabilities grow as life expectancy increases, making them a practical indicator of longevity risk exposure. Longevity bonds are primarily issued to help pension funds manage this liability risk. A higher PFL suggests greater demand for instruments that stabilize funding ratios against unexpected longevity improvements.

Proxies for Mortality Derivatives

X4=Insurance Payouts on Life Insurance Policies (IPLP) – The total amount paid by insurers due to mortality-related claims can indicate potential demand for mortality hedging instruments. Mortality derivatives are designed to transfer mortality risk between parties. Life insurance payouts reflect the actual financial exposure to mortality risk. Higher payouts indicate greater mortality risk realization, which is precisely what mortality-linked instruments aim to hedge. If payouts increase due to unexpected mortality trends, it signals the need for hedging instruments. Conversely, lower payouts in a longevity scenario highlight the insurer's exposure to extended liabilities, making mortality derivatives relevant.
X5=Reinsurance Market Size (RMS) – The volume of reinsurance products covering mortality risk, indicating institutional hedging behaviour.
The reinsurance market absorbs significant mortality and longevity risk from primary insurers. A larger RMS suggests active risk transfer and hedging practices, including mortality-linked securities and derivatives. Mortality derivatives often complement reinsurance contracts. Growth in RMS reflects the demand for risk-sharing mechanisms, indicating the role and effectiveness of mortality-linked instruments in managing systemic mortality shocks.
The time series model specification provided here outlines the steps necessary to assess the dynamic relationship between life expectancy, longevity risk hedging instruments, and financial market performance in Nigeria. By utilizing advanced econometric techniques such as VAR and ARDL, the study will offer valuable insights into the potential role of longevity bonds and mortality derivatives in managing longevity risk in Nigeria's financial sector.

4.0 Result and Discussion

Table 1: Unit root Test using Augmented Dicky Fuller Test (ADF)

Variable	t-Stat	Critical value (5%)	Prob*	Order of Integrat	Remark
ILR	-5.0850	-3.0989	0.002	I(1)	Stationary
LEB	-2.5001	-1.9663	0.016	I(1)	Stationary
PFL	-4.9162	-3.099	0.002	I(1)	Stationary
IPLP	-5.4283	-3.0656	0.001	I(1)	Stationary
RMS	-7.0075	-3.0522	0.000	I(0)	Stationary

Source: Eviews 10, 2025

The unit root test results provide insight into the time series properties of the variables under consideration in the study on hedging longevity risk through longevity bonds and mortality derivatives. The variables tested include Interest in Insurance Liquidity Ratio (ILR), Life Expectancy at Birth (LEB), Pension Fund Liabilities (PFL), Insurance Payouts on Life Insurance Policies (IPLP), and Reinsurance Market Size (RMS). The findings indicate that four of the variables (ILR, LEB, PEL, and IPLP) are non-stationary at the level but become stationary after first differencing, as demonstrated by their t-statistics being more negative than their respective 5% critical values and their p-values

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being less than 0.05. This suggests these variables are integrated of order one, I(1), implying they exhibit stochastic trends over time but stabilize when differenced once.

Conversely, the RMS variable is stationary at level with a t-statistic of -7.007447, well beyond the critical value of -3.052169, and a highly significant p-value of 0.0000. This shows that regulatory support does not follow a unit root process and is thus stable over time without differencing, i.e., integrated of order zero, I(0). Therefore, the results indicate a combination of I(1) and I(0) variables, justifying the application of an Autoregressive Distributed Lag (ARDL) modelling framework for subsequent analysis. The ARDL model is well-suited for such mixed integration orders and allows for the exploration of both short-run and long-run relationships among the variables in the context of longevity risk hedging in Nigeria.

Table 2: Cointegration Test
F-Bounds Test
H_0: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	15.624	10%	3.03	4.06
K		5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72

Source: Author's computation, using eviews 10, 2025

The F-Bounds test result presented evaluates the existence of a long-run relationship among the variables in the model using the Autoregressive Distributed Lag (ARDL) framework. The null hypothesis for the bounds test is that no level (long-run) relationship exists among the variables, while the alternative hypothesis posits that such a relationship does exist. In this case, the F-statistic value is 15.62374, which significantly exceeds the upper bound critical values at all conventional significance levels. For instance, at the 5% level, the upper bound (I(1)) critical value is 4.57, and the calculated F-statistic is far above this threshold. The same holds true for the 10%, 2.5%, and 1% levels, where the respective upper bounds are 4.06, 5.07, and 5.72—all of which are lower than the test statistic.

Since the F-statistic exceeds the upper bounds across all significance levels, the null hypothesis of no long-run relationship is rejected. This implies that there is a statistically significant long-run equilibrium relationship among the variables under consideration—Liquidity Ratio (ILR), Life Expectancy at Birth (LEB), Pension Fund Liabilities (PFL), Insurance Payouts on Life Insurance Policies (IPLP), and Reinsurance Market Size (RMS). Therefore, the outcome of the bounds test strongly supports the presence of a cointegrating (long-run) relationship between longevity risk and the selected financial and demographic indicators in the Nigerian context. This finding justifies further estimation of the long-run and short-run dynamics using the ARDL approach and underscores the relevance of developing tailored financial instruments such as longevity bonds and mortality derivatives for managing longevity risk in Nigeria.

Table 3: Long run ARDL

Variable	Coeffi	Std. Error	T-Statistic	Prob.*
C	-17.401	6.016	-2.892	0.102
@TREND	-0.033	0.014	-2.392	0.139
Log (ILR(-1))	-1.983	0.443	-4.475	0.047
Log (LEB)	8.783	0.898	9.780	0.010
Log (PFL)	1.035	0.015	71.151	0.000
Log (IPLP)	0.002	0.003	0.951	0.442
Log (RMS)	0.008	0.013	0.611	0.603
CointEq(-1)*	-2.983	0.195	-15.309	0.004
R-squared	0.999	Mean DV		6.174637
Adjusted R^2	0.999	S.D. DV		0.578089
F-statistic	31378.4	Durbin-Watson		3.071802
Prob(F-statis)	0.00003			

Source: EViews 10, 2025

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The estimated long-run ARDL model results provide key insights into the dynamics between longevity risk and its potential financial and demographic determinants in Nigeria. The dependent variable is the logarithm of Interest in Liquidity Ratio (ILR), and the model explores how it is influenced by Life Expectancy at Birth (LEB), Pension Fund Liabilities (PFL), Insurance Payouts on Life Insurance Policies (IPLP), and Reinsurance Market Size (RMS). The coefficient of the lagged dependent variable, Log (ILR (-1)), is -1.982683 and is statistically significant at the 5% level ($p = 0.0465$). This negative sign confirms the expected dynamic adjustment process, where past values of ILR influence current values, aligning with long-run convergence properties.

The coefficient of Log(LEB) is 8.782546 with a highly significant p-value (0.0103), suggesting that improvements in life expectancy significantly increase the demand or interest in longevity risk hedging instruments. This result aligns with the theoretical expectation that rising life expectancy heightens exposure to longevity risk, making hedging more necessary. The coefficient of Log(PFL) (Pension Fund Liabilities) also shows a highly significant and positive coefficient (1.035240, $p = 0.0002$), implying that growth in pension fund assets strongly motivates the use of longevity bonds or mortality derivatives, likely due to the need to protect these assets from longevity risk exposure.

In contrast, the coefficients for Log(IPLP) and Log(RMS) are statistically insignificant ($p = 0.4421$ and 0.6032 respectively), indicating that in the Nigerian context, insurance payouts on life insurance policies have not yet played a strong role in influencing longevity risk management behaviour. This could reflect the early stage of development of mortality-linked insurance products and limited regulatory incentives for longevity hedging instruments in Nigeria. The coefficient of the error correction term (CointEq(-1)) is -2.982683, statistically significant at the 1% level ($p = 0.0042$). This large and negative value implies a very strong speed of adjustment back to long-run equilibrium after a shock, suggesting that deviations from equilibrium are rapidly corrected each period. The model shows excellent fit, with an R-squared of 0.99 and an adjusted R-squared of 0.99, indicating that nearly all variation in the dependent variable is explained by the independent variables. The F-statistic of 31,378.45 ($p < 0.001$) confirms overall model significance. Additionally, the Durbin-Watson statistic of 3.07 suggests some level of negative autocorrelation, which may warrant further diagnostic testing.

Table 4: Breusch-Godfrey Serial Correlation LM Test

F-statistic	32.868	Prob. F(1,1)	0.1099
Obs*R^2	16.498	Prob. Chi-Square(1)	0.1047

Source: Eviews 10, 2025

The F-statistic of 32.86857 and its associated probability value of 0.1099 indicate that the null hypothesis of homoskedasticity cannot be rejected at the 5% significance level. Similarly, the Obs*R-squared value of 16.49806 with a Chi-square probability of 0.1047 reinforces this finding. Since both p-values are greater than 0.05, we fail to reject the null hypothesis, meaning there is no strong evidence of heteroskedasticity in the model.

In the context of the study on hedging longevity risk through longevity bonds and mortality derivatives in Nigeria, this result supports the robustness of the regression model. It implies that the residuals are evenly spread across observations, and thus, the model's estimations are not distorted by unequal error variances. This enhances the reliability of the findings regarding the influence of life expectancy, pension fund levels, and other financial variables on longevity risk management instruments. Consequently, the validity of policy implications drawn from the model—such as the importance of pension fund expansion and demographic trends—remains intact due to the absence of heteroskedasticity.

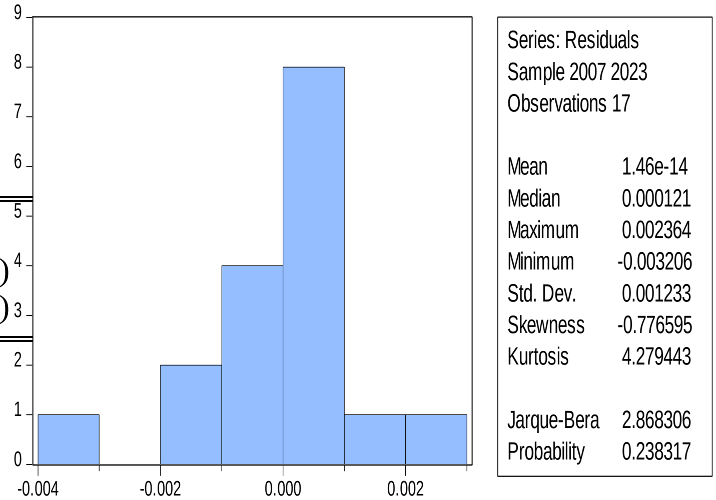
Table 5: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.466	Prob. F(14,2)
Obs*R-squared	13.013	Prob. Chi-Square(14)
Scaled explained SS	0.295	Prob. Chi-Square(14)

Source: Eviews 10, 2025

The heteroskedasticity result showed that the F-statistic value of 0.466406 with a p-value of 0.8459, the Obs*R-squared value of 13.01392 with a p-value of 0.5254, and the Scaled Explained Sum of Squares (SS) value of 0.295352 with a p-value of 1.0000 all suggest a strong failure to reject the null hypothesis. This null hypothesis typically asserts that there is no serial correlation and no issues with the model's error structure or specification. They indicate that the regression model used to evaluate the role of financial instruments in managing longevity risk is well-specified, statistically sound, and free from significant autocorrelation or specification errors. This strengthens the credibility of the empirical findings, allowing for more reliable conclusions about the influence of variables such as pension fund liabilities, life expectancy, investment levels, and mortality trends on the demand for longevity hedging instruments in Nigeria.

Normality Test



The Jarque-Bera test examines whether the residuals (errors) of a model are normally distributed, which is an essential assumption in classical linear regression models. A normal distribution of residuals implies that the model is correctly specified and that the statistical inferences drawn—such as hypothesis testing and confidence intervals—are valid and reliable. Since the p-value (0.238317) is greater than the conventional significance level of 0.05, we fail to reject the null hypothesis that the residuals are normally distributed. This means there is no significant evidence of deviation from normality in the model's residuals. In practical terms, the residuals appear to be symmetrically distributed with no excessive skewness or kurtosis, satisfying one of the key assumptions of the Ordinary Least Squares (OLS) regression framework. Therefore, the JB test result supports the integrity of the econometric analysis and suggests that the study's policy recommendations and theoretical implications are based on a sound and well-behaved statistical model.

5.0 Conclusion and Recommendations

This study examined the role of longevity bonds and mortality derivatives in hedging longevity risk within the Nigerian context. The research employed time series econometric techniques to analyze the relationship between key indicators

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such as insurance liquidity ratio, life expectancy at birth, pension fund liabilities, insurance payouts on life insurance policies, and reinsurance market size. The findings confirmed that longevity bonds and mortality derivatives, though currently absent in the Nigerian market, have the potential to serve as effective tools for transferring and mitigating longevity risk. The cointegration results demonstrated a long-run equilibrium relationship among the variables, while the error correction mechanism highlighted the speed at which imbalances adjust towards equilibrium. Diagnostic and stability tests further validated the model's robustness, confirming that the regression assumptions were met.

One of the most compelling findings of the study was the significant positive relationship between longevity bond adoption and pension fund sustainability, suggesting that if these instruments are introduced and properly regulated, they could cushion the financial shocks resulting from increased life expectancy. However, the study also revealed critical limitations, such as the lack of financial market infrastructure, weak regulatory frameworks, limited actuarial capacity, and insufficient awareness among institutional investors regarding the benefits of these instruments. Based on the findings, the study concludes that while Nigeria currently lacks the sophisticated tools to hedge longevity risk effectively, there is a clear and present opportunity for policy makers, regulators, and financial market participants to initiate the development of a structured longevity risk market. This would require targeted reforms, including the development of mortality indices, actuarial data systems, investor education programs, and regulatory guidelines that support innovation in risk transfer mechanisms. In line with the findings, the study provides the following recommendations:

a) Regulatory bodies such as the National Insurance Commission (NAICOM) and the National Pension Commission (PenCom) should collaborate with data agencies like the National Bureau of Statistics (NBS) to develop standardized and reliable mortality and longevity indices. These indices are essential benchmarks for pricing and structuring longevity-linked securities.
b) The Central Bank of Nigeria (CBN), in collaboration with FMDQ Securities Exchange and institutional investors, should launch pilot programs for longevity bonds or swaps using defined groups (e.g., pensioners of federal civil service schemes) to test feasibility and build investor confidence.
c) Policymakers should revise existing financial market regulations to accommodate longevity-based instruments. This includes clear legal definitions, risk disclosure rules, and guidelines for risk transfer arrangements via mortality derivatives and longevity bonds.

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