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Assets and Liabilities Management: A Determinant of Financial Performance of Pension Funds Administrators (PFAs)

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ABSTRACT

The financial performance of pension fund administrators is greatly influenced by their ability to effectively manage assets and liabilities. Therefore, this study aims to investigate asset and liability management on financial performance, focusing on the relationship between Asset Liability Management and the profitability of Pension Funds Administration (PFA) in Nigeria. The research utilized a convenience sampling method and collected data from secondary sources (e-view). The research design adopted was Expost factor, and the cross-sectional data was sourced from 12-PFA companies, covering the years 2010-2021. Descriptive analysis and inferential statistics, including stationarity tests and correlation analysis, were conducted to assess the suitability of the data. Additionally, Hausman's zest was performed to validate the hypothesis. The findings indicate that the variables adequately represent and demonstrate the relationship between asset liability management and the profitability of pension fund companies. Thus, this paper provides empirical evidence that the effects of asset and liability management have an overall impact on the financial performance of Pension fund administration in Nigeria.

1. Introduction

Asset and liability management plays a crucial role in the financial performance of pension fund managers (PFA) in Nigeria (Muraina, 2023). The responsibility of a Pension Administrator is to safeguard pension funds and ensure that they are invested wisely to generate returns that meet pension obligations. Concurrently, they must effectively manage their obligations, including pension payments and administrative expenses. This study aims to analyze the impact of asset and liability management on the financial performance of financial institutions in Nigeria, with a specific focus on identifying the key factors that influence its effectiveness in achieving sustainable financial performance of PFAs.

Furthermore, effective asset and liability management enable financial institutions in Nigeria to enhance investment returns and improve their overall financial performance. Ogungbade et al. (2022), pension administrators must allocate pension funds efficiently across various asset classes, considering factors such as risk tolerance, investment opportunities, and regulatory requirements. Carefully selecting investments, diversifying investment portfolios, and managing risks effectively, public finance can generate attractive returns while preserving capital, as emphasized by Fadun and Oye (2020). Enhancing investment returns significantly contributes to the financial strength and profitability of institutions like PFAs. Therefore, this study will test the hypothesis regarding the existence of a significant relationship between Assets Liabilities Management and Returns on Investments of the Pension Funds Administration Companies in Nigeria.

To effectively manage assets and liabilities, it is imperative for pension administrators to implement comprehensive risk management practices. Series of challenges faced by PFAs in Nigeria is the absence of robust asset allocation strategies, as highlighted by Obasa (2022). The lack of clearly defined investment policies, risk assessment procedures, and diversification strategies can impede the ability of PFAs to achieve optimal investment returns. Poor asset allocation practices may result in either under-exposure or over-exposure to specific asset classes, thereby affecting the financial performance of PFAs.

Conducting thorough risk assessment procedures and adopting suitable risk mitigation strategies are crucial steps in minimizing potential losses and ensuring financial stability. The asset liability management (ALM) office plays a pivotal role in providing research and recommendations on management approaches and asset allocation strategies.

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Therefore, this paper underscores the significance of asset liability management for PFAs, as it enables them to make informed decisions when investing in assets that offer higher returns. Acquiring knowledge in this area will empower PFAs to maximize returns and attract retirement savings contributions from employees. Consequently, the study aims to evaluate the correlation between asset liability management and Returns on Investments of Pension Funds Administration Companies in Nigeria.

2. Literature review

The paper conducted by Ukpong and Olowokudejo (2021) delves into the correlation between Asset and Liability Management (ALM) and profitability in the banking sector, focusing on strategic measures of bank profitability. On the other hand, Joaqui-Barandica and Manotas-Duque (2022) along with Ukpong and Olowokudejo (2021) have conducted extensive research on ALM within pension fund companies, emphasizing solvency, stochastic analysis, and profitability.

Despite the significant amount of research in the banking and pension fund sectors, there is a noticeable gap in the literature regarding the relationship between ALM and profitability in Pension Fund Administrators (PFAs), as highlighted by Healy (2021). Moreover, while the Stochastic Control Approach (SCA) model has been utilized in the banking industry, its application in the pension sector, particularly in PFAs, remains relatively unexplored.

Given that banks, pension funds, and pension companies operate within the same financial sector, there is a compelling argument for applying the SCA model to PFAs to evaluate their efficiency and effectiveness. This suggests a potential avenue for future research to bridge the existing gap in understanding the relationship between ALM and profitability in the context of PFAs.

The primary objective of this research is to fill the existing research gap and provide significant contributions to the field by investigating the correlation between Asset Liability Management (ALM) and profitability in Pension Fund Administrators (PFAs). The outcomes of this study are anticipated to offer insurers a valuable database and resource material on ALM and profitability. Additionally, this research aims to enhance the current literature by presenting specific results related to PFAs in a developing nation such as Nigeria. The theoretical perspective, conceptual framework, and empirical analysis were thoroughly examined and discussed in this paper.

Theoretical Framework

The theory of asset-liability management (ALM)

Asset Liability Management (ALM) is crucial for managing maturity gaps and mismatches within financial institutions. Maturity gaps, a subset of structural gaps, underscore the significance of balancing maturities and cash flows on both sides of the balance sheet. The primary objective is to achieve equilibrium in these gaps by offering timely guidance on adjusting the focus towards appropriate product types and tenors, while actively engaging asset liability committees in the decision-making process.

Duration serves as a vital metric for assessing interest rate sensitivity in the context of ALM. According to Lin et al. (2022), Macaulay's duration is widely recognized as a dependable measure of the duration of a portfolio's discounted cash flows throughout the life of an asset or liability. It is customary to calculate the duration of portfolios for various product types as well as at an aggregate portfolio level. This metric is particularly valuable for predicting how future events may impact the duration of a portfolio. Macaulay duration computes the weighted average time-to-maturity of a bond's cash flow, with the weights assigned based on the present values of the cash flows Shah et al. (2020).

The ALM theory encompasses various aspects, including the management of dynamic and static gaps. Through the use of reports, future gap positions are simulated by taking into account projected business volumes and the exercise of options. Furthermore, the introduction of new volumes, prepayment transactions, and assumed deposit roll-overs can give rise to substantial ALM gaps. These elements play a vital role in efficiently managing the asset-liability relationship and safeguarding the financial stability of an organization Džmuráňová (2020).

Modern Portfolio Theory (MPT)

The Modern Portfolio Theory (MPT) has been identified as a suitable theory for examination purposes. It was initially introduced by Harry Markowitz in 1952, which marked a significant milestone in the field of financial economics Akkaya (2021). Markowitz, a highly regarded American economist, was later awarded the Nobel Prize in Economic Sciences in 1990 for his pioneering contributions to this area of study.

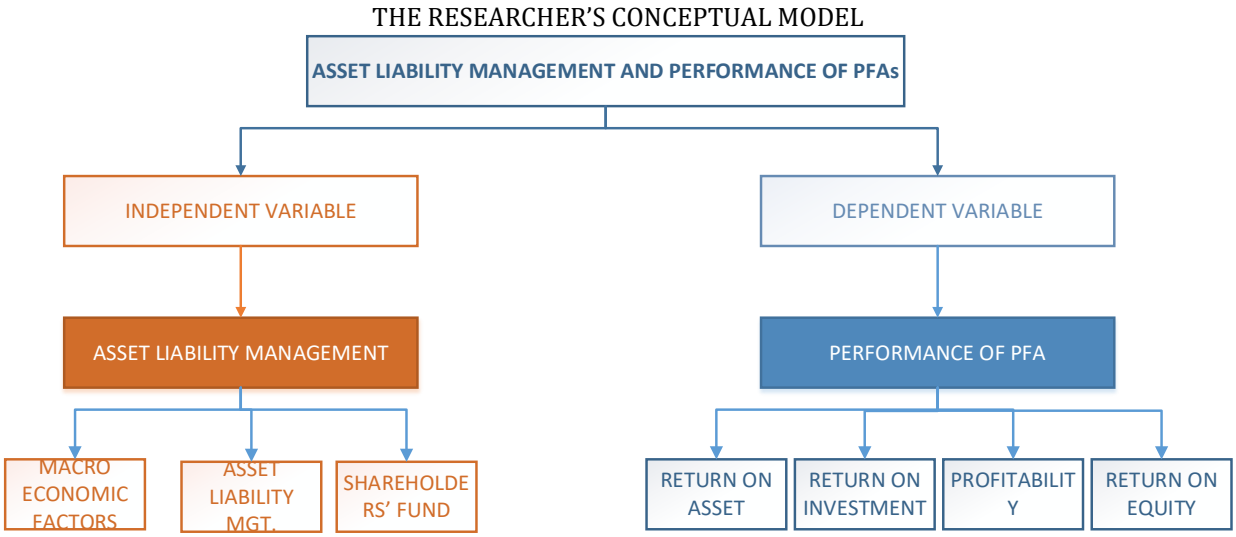
MPT revolutionized investment strategies by emphasizing the importance of diversification. Instead of assessing the risk of a portfolio based on the individual risks of its components, the theory highlights the significance of understanding how these components interact with each other to determine the overall risk of the portfolio.

Markowitz's groundbreaking work paved the way for a better understanding of the complex relationship between risk and return within a portfolio. It emphasized the need to not only pursue higher

returns but also effectively manage risk through diversification. As a result, it has reshaped the approach that investors take towards portfolio construction and risk assessment.

The significance of Modern Portfolio Theory (MPT) in relation to pension performance lies in its ability to greatly impact the financial performance of the Pension Fund Administration (PFA) in Nigeria through the management of assets and liabilities. MPT serves as a vital tool by providing a systematic framework that allows PFAs to effectively construct and manage portfolios. This is particularly crucial for PFAs as they bear the responsibility of safeguarding the financial interests of pension contributors. By adhering to MPT principles, PFAs can optimize their investment portfolios by diversifying across various asset classes. This diversification aids in achieving a balance between risk and return. Additionally, MPT offers a strategic approach for PFAs to align their investment decisions with the long-term obligations of the fund. This ensures that assets are prudently managed to meet future liabilities. By embracing MPT, PFAs can enhance the resilience of their portfolios, potentially leading to an improved overall financial performance. Ultimately, this enables PFAs to fulfill their fiduciary responsibilities to pension contributors in Nigeria.

Conceptual Framework



Author Concept: 2023

According to Udaibir, et al (2017), the improvement of firm performance can be achieved by effectively earning on assets and managing associated liabilities. This performance is determined by factors such as return on investment, asset profitability, and return on equity. The ability of organizations to generate earnings from their assets and liabilities is crucial for their overall financial performance and survival. In Nigeria, proper management of assets and liabilities is of utmost importance for organizations to enhance productivity and achieve growth in their financial, corporate, and pension investments. Therefore, it is essential for PFAs organizations to optimize their asset allocation strategies in order to maximize returns and minimize risks.

The strategic allocation of assets is crucial for Pension Fund Administrators (PFAs) to achieve consistent investment returns and ensure fund growth to meet pension obligations. In developing countries like Nigeria, effective management of assets and liabilities is essential for enhancing the overall performance of pension fund administration. Asset and liability management plays a critical role in liability matching and risk mitigation for PFAs by aligning the duration, cash flow patterns, and risks associated with pension liabilities with suitable earning assets to ensure the availability of funds for pension payments.

By aligning assets and liabilities, PFAs can reduce the risk of liquidity mismatches and safeguard against fluctuations in interest rates, credit risks, and other market uncertainties. Implementing effective risk mitigation strategies enables PFAs to fulfill their obligations and strengthen the financial stability of pension fund administration. This approach is vital for ensuring the long-term sustainability and growth of pension funds, ultimately benefiting pensioners and the overall economy.

Empirical Review

The strategic management of a business entity's assets and liabilities, known as asset and liability management (ALM), is based on an empirical framework. In a recent study by Bogentoft et al. (2020), the impact of ALM on the profitability of Ghanaian national investment pension funds management was investigated. The findings revealed that the valuation of assets and liabilities significantly influenced the profitability of pension funds management. Interestingly, a decrease in asset valuation was found to improve the performance of pension fund administration. Additionally, the study identified a direct correlation between inflation rate and profitability.

In different empirical research conducted by Gu, Kelly and Xiu (2021), the focus was on identifying patterns in the funding and asset allocation of pension plans among various U.S. corporations. The researchers utilized econometric models to analyze the advantages of incorporating dynamic strategies for the variances and covariances/correlations of asset returns in pension fund portfolio construction and risk management. The study suggests that this approach has the potential to capture the characteristic features of asset returns and could have significant implications for optimal asset portfolio construction.

Alwohaibi, et al. (2022) implemented a strategy that enhances decision-making flexibility by utilizing a sample-path representation of uncertainties, thus circumventing the computational complexities linked with stochastic programming. By categorizing sample paths with similar attributes of the pension fund at each time point and permitting decisions to differ among various groups of sample paths, they were able to achieve dynamic decisions at a manageable computational expense while addressing significant uncertainty through path utilization. Interestingly, they noted that the problem size and solution times remained consistent, irrespective of the utilization of grouping.

Tamiru (2013) utilized a statistical cost accounting model to assess profitability based on the balance sheet and macroeconomic variables in Ethiopia, focusing on a sample of eight banks from 2005 to 2010. The model posited that the rate of return on assets had a positive relationship and varied with assets, whereas the cost of liabilities had a negative relationship and varied across liabilities. Hence, this study determines the PFA's performance on asset and liability of management.

3. Methodology

The data collection process utilized a descriptive survey research design aimed at describing and interpreting the current situation regarding asset and liability management and pension fund administration. Secondary data (e-view) was the instrument of choice due to its ability to collect highly confidential information without exposing the researcher to potential risks associated with other methods such as observation. The study population consisted of 12 licensed PFAs authorized by PENCOM to operate in the Nigerian pension market during the study period. Ten (12) PFAs met these criteria and were duly selected as the sample size for this study. The sample size selection criteria were based on the companies' existence throughout the study period (2010–2021) and the availability of financial statements. Companies such as FCMB Pension, ARM Pension, FUG PFA, Radix PFA, OAK PFA, Fidelity PFA, IEI ANCHOR PFA, Leadway PFA, Crusader Sterling PFA, Trust Fund PFA, IBTC PFA and PAL PFA that met these criteria and were chosen as the sample for the study. Data collection involved purposive and convenience sampling methods using secondary data (e-view) sourced from the National Pension Commission Database and the websites of the selected pension fund administrations. The collected data were analyzed using Pearson's correlation and logistic regression to determine the relationship between independent and dependent variables, with regression models formulated to represent this relationship.

$$\text{Financial Performance (Y)} = \alpha_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + e\ it$$

Were
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = represents the coefficients for the independent variables.
α_0 = represents the intercept for X variable of performance of PFA.

In examining the effect of ALM on the profitability PFA companies, the statistical cost accounting (SCA) model is adopted. This model was first postulated by Hester and Zoellner (1966) and had subsequently been adopted by Hes‌ter and Pierce (1975), Kwast and Rose (1982) Vasiliou (1996) and (Ukpong, & Olowokudejo, 2021). The SCA model is based on the assumption that the rate of return of earning assets is positive and varies across assets whereas the rate of cost on liabilities is negative and varies across liabilities, Its basic theoretical framework is based on the fact that ALM has potentially positive or negative energy on the profitability of financial firms in the presence of other factors such as the market structure and macroeconomic conditions. These macroeconomic factors have been incorporated by Kwast and Rose (1982), Bhattarai (2020). Nguyen, Bui and Topal (2023) stated that in a bid to present the traditional model in a modified way, if these factors are not included in the model, the regression results may be unreliable and the coefficients biased. Thus, the SCA model is basically:

$$Y_{it} = \alpha_1 + \sum \alpha_{2i} A_{ilt} + \sum \alpha_{3j} L_{jkt} + e_{lt} \quad \text{.....(1)}$$

Were
Y represents the profit of the firm
A_t, is the ith asset, i = 1,2.....m
Lj is the jth liability, j = 1,2,....n
l-represents the number of firms, l = 1,2.,..k,

t is the time period, t = 1,2,…..*T*
$\alpha_{2i}$is the rates of return and shows the variations in profit by replacing one unit of cash with one unit of the *i*th asset and is expected to be positive or non-negative.
α_{2i} represents the rate of cost of liabilities and indicates the changes in profit by adding one unit of cash and one unit of *j*th liability and is expected to be negative or non-positive.
α_{3j} is a constant term, and *elt*, is the stochastics error term accounting for stochastic differences among the firms Ukpong and Olowokudejo (2021)

Sarker and Datta, (2022) in adopting this model for the Pension industry stated it thus:

$$Yit = c + \sum^{k}_{k=1} \beta_k X^k_{it} + \varepsilon_{it} \quad \text{.....(2)}$$
$$\varepsilon_{it} = Z_i + U_{it}$$

Where
Y_{it} is the profitability of the PFA company *i* at time *t*, with *i* = 1…,N; t = 1…, T.
X_{it} are k independent variables;
$\varepsilon_{it}$is the disturbance term with Z_i being the unobserved Pension-specific effect and $\underline{u}_{it}$ being the idiosyncratic error as a one-way error component regression model.

Table 1. A description of both the explained and explanatory variables and their apiori expectations is as follows

Variablc Profitability	Description	Expected sign
ROA Assets	Return on assets Profit after tax/total assets	
	Cash and cash equivalents	Positive (+)
	Financial assets	Positive (+)
	Debtors and prepayments	Positive (+)

Source: Author (2023)

Assumption:
This analysis assumes that companies with a negative return of assets are assigned a probability ratio (Y) of zero. Secondary data collected is prepared in Microsoft excel and imported to E-views 9 for analysis. Panel data analysis is carried out in line with the objectives of the study. Hsiao(2022) opines that the advantage of using panel data is that it controls for individual heterogeneity and less collinearity among variables. Moreover, trends in the cross sectional data can easily be tracked which would have been difficult to achieve with either the trend series or the cross sectional data Cohen et al. (2017) ;Liu et al. (2024). The time series data also allows for dynamic adjustment. Data is subjected to descriptive statistics, correlations, and panel data regressions. The Hausman test is used to determine the preferred model out of fixed effect and random effect models.

The study has two measurement variables (assets and liabilities management and pension funds administration), to analyzing the data (hypothesis test). Pension funds administration was the dependent variable for the study. While that Asset Liabilities Management was independents variables of the study

4. Data Analysis

Data Presentation

Table 2 below displays the statistical summaries of both the explanatory and explained variables, derived from a dataset amalgamated from 12 PFA firms, total of 144 observations. Table 2 below displays the statistical summaries of both the explanatory and explained variables, derived from a dataset amalgamated from 12PFA firms, totaling 144 observations.

Table 2. Descriptive statistics

Date: 01/10/24 Time: 16:43
Sample: 1 144

	LOG(ROA)	LOG(TA)	LOG(TL)	LOG(TAL)	LOG(SF)	GDP	INF
Mean	4.885397	6.128833	5.314074	6.296071	4.017417	0.031967	0.123542
Median	5.592256	6.459876	5.715045	6.577915	6.046051	0.031500	0.121600
Maximum	8.103478	9.235765	8.971746	9.342364	9.103950	0.080100	0.169500
Minimum	0.000000	0.000000	0.000000	0.000000	0.000000	-0.017900	0.080500
Std. Dev.	2.278837	1.906392	1.943704	1.881561	3.283541	0.030011	0.028984
Skewness	-1.384977	-2.361453	-1.578092	-2.401245	-0.312024	-0.181686	0.104959
Kurtosis	3.635541	8.556420	5.665103	9.139082	1.342280	2.073107	1.875615
Jarque-Bera	48.45932	319.0779	102.3856	364.5134	18.82482	5.947018	7.849842
Probability	0.000000	0.000000	0.000000	0.000000	0.000082	0.051124	0.019744
Sum	703.4972	882.5520	765.2266	906.6343	578.5081	4.603200	17.79000
Sum Sq. Dev.	742.6131	519.7091	540.2518	506.2590	1541.775	0.128796	0.120129
Observations	144	144	144	144	144	144	144

Source: Researcher's computation from E-views 12

Analysis of data

A unit root test was conducted on the dataset to examine its stationarity. Given the substantial magnitude of assets and liabilities values, a logarithmic transformation to the base 10 was applied to the data for this and subsequent analyses. This transformation aimed to reduce data variability, ensure uniformity, and produce more reliable outcomes. Both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests using Fisher's chi-square were utilized to assess stationarity. These tests evaluate the null hypothesis of a unit root against the alternative that the time series data for the variables are stationary. Rejecting the null hypothesis indicates that the series is stationary, implying it is integrated at order zero. Conversely, if the series is non-stationary, it is integrated at a higher order and must be differenced until it achieves stationarity or reaches the second order differencing, whichever occurs first.

Table 3. The Unit root test

Variable	ADF		PP-Fisher chi square		Order of Integration
	Statistics	Probability	Statistics	Probability	
LOG(ROA)	-6.586044	0.0000	-6.447905	0.0000	I(0)
LOG(TA)	-9.224178	0.0000	-8.995008	0.0000	I(0)
LOG(TL)	-8.298251	0.0000	-7.925701	0.0000	I(0)
LOG(TAL)	-8.857591	0.0000	-8.637182	0.0000	I(0)
LOG(SF)	-4.202187	0.0009	-4.201433	0.0009	I(0)
GDP	-12.25448	0.0000	-6.322316	0.0000	I(0)
INF	-7.919895	0.0000	-8.895453	0.0000	I(0)

Source: researcher's computation from E-views 12

The table reveals that all the variables exhibited stationarity at level I(0). This suggests the absence of a unit root in all studied variables, indicating no shocks in the model and a likelihood that future statistical patterns will replicate past behavior.

Correlation analysis

To determine the degree of relationship between the variables, a correlation analysis was performed. This is due to the propensity of multiple independent variables in a research investigation to provide an inflated and deceptive contribution valuation while elucidating the dependent variable. When two or more independent variables have substantial collinearity (0.7 and above), this is typical. Regression coefficients with very large standard error estimates might result from multicollinearity. As a result, incorrect inferences regarding the importance of the independent variables in the model under study may be drawn. The idea that independent variables in a research analysis are interdependent would be violated by this.

Correlation coefficient values fall within the range of +1 to -1. A perfect positive link between the two variables is shown by a correlation value of +1, whilst a perfect negative association is indicated by a correlation coefficient of -1. There isn't a linear relationship between the variables when the correlation coefficient is zero. This study employed the most popular bi-variant correlation statistic, the Pearson product correlation, and the results are shown in the table below.

Table 4. Pearson correlation matrix

Covariance Analysis: Ordinary
Date: 01/10/24 Time: 11:35
Sample: 1 144
Included observations: 144

Correlation Probability	LOG(ROA)	LOG(TA)	LOG(TL)	LOG(TAL)	LOG(SF)	GDP	INF
LOG(ROA)	1.000000						
LOG(TA)	0.512135 0.0000	1.000000					
LOG(TL)	0.509048 0.0000	0.758970 0.0000	1.000000				
LOG(TAL)	0.569563 0.0000	0.950296 0.0000	0.836679 0.0000	1.000000			
LOG(SF)	0.415785 0.0000	0.278937 0.0007	0.206741 0.0129	0.284846 0.0005	1.000000		
GDP	-0.252543 0.0023	-0.263663 0.0014	-0.177930 0.0329	-0.288019 0.0005	-0.107113 0.2013	1.000000	
INF	-0.012415 0.8826	-0.026332 0.7541	-0.106194 0.2052	-0.030288 0.7186	-0.054985 0.5128	-0.470563 0.0000	1.000000

*Source: Authors computation from E-views 12 * probability values significant at 5% level*

The correlation matrix of the variables, as determined using the E-views 12 statistical software, is displayed in the table along with the coefficients and probability at the 0.05 level of significance. The correlation coefficient, which reflects the degree of correlation between the variables, is represented by the upper value, and its significance is shown by the probability values displayed in the lower value. It is evident that the majority of the variables' correlation coefficients are less than 0.5. No relationship is perfect; none is positive (+1) or negative (-1). This lends support to the collected data and its appropriateness for the study by demonstrating the lack of multicollinearity among the variables.

Table 5. Regression Analysis

Dependent Variable: LOG(ROA)
Method: Least Squares
Date: 01/10/24 Time: 12:38
Sample: 1 144
Included observations: 144

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(TA)	-0.319331	0.257003	-1.242518	0.2162
LOG(TL)	0.142715	0.145194	0.982929	0.3274
LOG(TAL)	0.739991	0.314914	2.349816	0.0202
LOG(SF)	0.193268	0.047517	4.067348	0.0001
GDP	-8.062815	6.008707	-1.341855	0.1819
INF	-1.782541	5.982406	-0.297964	0.7662
C	1.126613	1.120484	1.005470	0.3164

R-squared	0.416031	Mean dependent var	4.885397
Adjusted R-squared	0.390456	S.D. dependent var	2.278837
S.E. of regression	1.779163	Akaike info criterion	4.037553
Sum squared resid	433.6627	Schwarz criterion	4.181919
Log likelihood	-283.7038	Hannan-Quinn criter.	4.096215
F-statistic	16.26694	Durbin-Watson stat	0.956740
Prob(F-statistic)	0.000000		

Source: Authors computation from E-views 12

Data Interpretation

The E-views programme adds an intercept to the model, as shown in the table below, so that the estimations are relative to the constant term and add up to zero. The intercept does not reduce the degree of freedom because it is not a new variable to estimate. Instead, it is the mean of certain cross-sectional intercepts, which are already variables. Table shows that the total liabilities LOG(TL), total assets and liabilities LOG(TAL), and total liabilities LOG(TL) are all positively but not significantly related to ROA.

The study's factors can predict 41.6% of the profitability of insurance firms, according to the coefficient of determination (R2) stat of 0.416031. How well the regression model describes the fluctuations in the dependent variable is indicated by the modified R2. With an adjusted R2 of 39%, it can be concluded that while changes in the independent variables account for 39% of the variation in ROA, additional factors not included in the model account for 61% of the change. This indicates that the variables fairly explain the relationship between asset liability management and insurance companies' profitability.

The p-value corresponding to the observed F-statistic is displayed by the F-statistic, which calculates the standard F-test of the joint hypothesis. An F-Stat Probability of 0.0000 in the regression strengthens the model's validity and indicates that it fits the data well. This is because most of the models are significant.

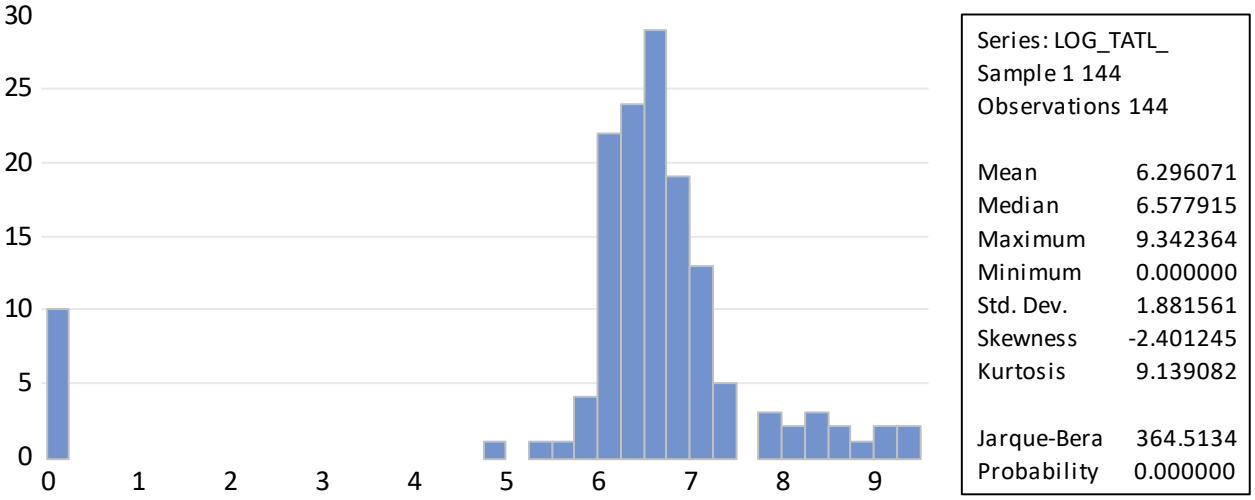


Figure 1. Hausman's zest was performed to validate the hypothesis

5. Conclusions

The study objectives assess Asset Liabilities Management and performance of pension funds administration in Nigeria. The statistical cost accounting (SCA) model was employed and a panel data approach was used with time series data from 2010 - 2021 covering 12 pension funds administration companies. The central hypothesis of the SCA model was confirmed as most of the estimated rate to determine the degree of relationship between the variables, a correlation analysis was performed. This is due to the propensity of multiple independent variables in a research investigation to provide an inflated and deceptive contribution valuation while elucidating the dependent variable. These tests evaluate the null hypothesis of a unit root against the alternative that the time series data for the variables are stationary. Rejecting the null hypothesis indicates that the series is stationary, implying it is integrated at order zero. Conversely, if the series is non-stationary, it is integrated at a higher order and must be differenced until it achieves stationarity or reaches the second order differencing, whichever occurs first.

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