

# Inflation Hedging Potentials of Real Estate and Property in a Mixed Asset Portfolio of Nigerian Pension Fund

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## Abstract

This study investigates the inflation hedging capabilities of real estate as an asset class within the Nigerian pension fund portfolio. It evaluates both short-run and long-run hedging performance against actual, expected, and unexpected inflation. The research employs monthly time series data from 2008 to 2024 (204 observations) sourced from the National Pension Commission (PenCom), Central Bank of Nigeria (CBN), and National Bureau of Statistics (NBS). Ordinary Least Squares (OLS) regression was used to assess short-term hedging effectiveness, while Johansen cointegration analysis examines long-run equilibrium relationships between real estate returns and inflation components. The results show that real estate provides a complete hedge against actual and expected inflation over the full study period. During the economic crisis period (2016–2024), it continued to offer a complete hedge for actual inflation and a partial hedge for expected and unexpected inflation. In contrast, during the pre-crisis period (2008–2015), real estate exhibited a perverse or weak hedge, particularly for unexpected inflation. These findings offer valuable guidance for the National Pension Commission and pension fund administrators, emphasizing the importance of allocating assets toward real estate during periods of high inflation. Investment managers can use this evidence to enhance long-term capital preservation strategies. This study provides the first comprehensive empirical analysis of the inflation-hedging role of real estate within the Nigerian pension fund context. It fills a critical gap in the literature by examining inflation in its decomposed form and linking it to economic cycle phases, offering nuanced insights for policymakers and institutional investors.

**Keywords;** Real Estate and Property, Inflation Hedging Potentials, Mixed Asset Portfolio, Pension Fund, Nigeria

## Introduction

Pension funds are collective investment schemes established to ensure long-term income security for contributors after retirement. Their primary goal is to accumulate and manage assets through contributions and investment income to fulfill future pension obligations reliably and efficiently (Kusiluka & Kongela, 2020). According to Myers, (2016), contributors prioritize high returns, stable performance, low fees, and liquidity, making strategic asset allocation critical in pension fund management.

Among macroeconomic risks, inflation stands out as a major threat to the real value of long-term investments. It erodes purchasing power and negatively impacts investment performance, particularly in countries experiencing economic instability. Inflation is typically defined as a sustained increase in the general price level, driven by various factors such as cost-push pressures, demand imbalances, and monetary expansion (Adekoya et al., 2023; Papathanasiou et al., 2023). For institutional investors, mitigating inflation risk is essential to preserving capital in real terms.

Globally, there has been a growing shift in pension fund allocations toward alternative asset classes, with real estate being one of the recognised asset (Carlo et al., 2023). Over the past three decades, real estate has gained increased recognition due to its inflation-hedging properties, low correlation with traditional financial assets, and potential to deliver stable, risk-adjusted returns (Fraser, 2022). Real estate investment also benefits from mechanisms such as rent indexation and asset appreciation, which enable it to respond to inflationary pressures. These advantages make it an appealing option for long-term institutional portfolios (Hoesli et al., 2022).

In Nigeria, studies have highlighted the diversification and performance-enhancing benefits of integrating real estate into pension fund portfolios (Umeh & Okonu, 2018). Moreover, scholars have recommended an increased allocation to real estate securities as a strategy to enhance returns due to the liquidity advantages (Ametefe, 2018; Kim & Park, 2022). Given the established theoretical relationship between real estate and inflation, the asset class warrants closer examination in high-inflation economies like Nigeria.

The Nigerian macroeconomic environment has experienced persistent inflationary pressures over the last decade, with double-digit inflation rates becoming the norm (NBS, 2024). This sustained inflation has significantly eroded the value of the Naira and affected investors' ability to preserve wealth. For pension funds, which are inherently long-term in nature, the risk of inflation devaluing accrued contributions poses a serious challenge. If not properly mitigated, these funds may fail to meet retirees' future income needs (Taderera & Akinsomi, 2020; Ekomabasi & Ekong, 2023).

To counter this, fund managers must prioritize inflation-resilient assets within a diversified portfolio. Real estate, widely viewed as a stable and secure investment, has been proposed as a potential hedge in both developed and emerging markets (Yeap & Lean, 2017). However, most inflation-hedging studies have focused on traditional financial assets such as equities

and bonds (Salisu et al., 2020), while limited attention has been given to real estate in the Nigerian pension context.

Despite increasing interest in real estate investment within Nigeria's pension sector, empirical evidence on its inflation-hedging performance remains scarce. Existing studies (e.g., Umeh & Okonu, 2018; Bernard, 2020; Ibikunle, 2022) have generally examined asset performance or allocation efficiency but fall short of evaluating real estate's ability to hedge inflation. This study addresses that gap by empirically investigating the short- and long-term inflation-hedging potentials of real estate within the Nigerian pension fund portfolio. It contributes to the literature by applying a dual-method approach—OLS regression for short-run dynamics and Johansen cointegration for long-run relationships—while also accounting for different economic periods (pre-crisis and crisis years). The findings aim to inform more inflation-resilient investment strategies for pension fund managers and institutional investors in Nigeria.

## **Literature Review**

### **The Nigerian Pension Fund**

Pension scheme in Nigeria is funded by contributions from the employers of labour or from both the employer and the employees (Pension Reform Act, 2014). Furthermore, employees in the public and private sectors with 15 years and above in active service shall be entitled to pension upon retirement from service. The contributions for any employee to which the Pension Reform Act (PRA) applies shall be a minimum of 10% by the employer and 8% by the employee. An employer may also agree to bear the full responsibility of the contribution provided it is not less than 20% of the monthly emolument of the employee. A good pension plan should not only serve as an incentive for employees but also helps the employer retain/attract experienced members of staff. The management of pension in Nigeria is inundated by multiple and diverse problems. The pension fund managers are faced with the problem of determining appropriate investment portfolios to ensure safety of the investible fund and provide adequate safeguard for pension fund assets. Also, the regulations on investment of pension fund assets are focused at deepening the pension market, particularly by enlarging the list of allowable investment instruments open to pension fund operators. Conversely, this makes the market to be open to more risks given the sensitivity of the pension assets and the volatility of the instruments.

Prior to 2004, the Nigerian pension industry under the old defined benefit pension system (in which the retirement benefits were fixed) had a deficit of over ₦2 trillion. Since the 2004 reform introduced the Contributory Pension Scheme (CPS), the industry has witnessed exponential growth. The Pension Reform Act 2014 repealed the 2004 Pension Reform Act. It governs and regulates the administration and management of the uniform CPS for both the public and the private sectors in Nigeria. As at the end of September 2015, total pension contribution in the custody of Pension Fund Custodians (PFCs) and under the management of Pension Fund Administrators (PFAs), including closed PFAs was in excess of ₦4.8 trillion. However, this figure was only 5% of the country \$510 billion GDP compared to 170% in Netherland, 131%

in Britain and 113% in the US. Moreover, 6.5 million out of 80 million working population enrolled into the CPS.

In Nigeria, the investments of pension fund assets are regulated by the National Pension Commission (PenCom) as provided under Part XII of Section 85-91 of the Pension Reform Act (PRA) 2014. Section 85(1) stipulates that all fund realized under the CPS shall be invested by the PFA with the objectives of safety and maintenance of fair returns on the amount invested. Section 86 lists the asset classes that pension fund invest in, real estate development investments also form part of the modes. Real estate investment in the Nigerian pension fund is presently at 1-5% level for both listed and non-listed RE (PRA, 2014).

### **Inflation Hedging Potentials of Real Estate**

Inflation is widely recognized as a persistent increase in the general price level of goods and services, resulting in the erosion of purchasing power over time. It may also be viewed as a decline in the value of money due to increased monetary supply or economic shocks (Umeh & Oluwasore, 2015; Dridi & Boughrara, 2023). While commonly defined as “too much money chasing too few goods” (Shilongo, 2019), inflation is more precisely understood through its components—actual, expected, and unexpected inflation. Actual inflation reflects realized price changes, expected inflation captures anticipations embedded in interest rates, and unexpected inflation arises from unanticipated economic developments (Bello, 2004). This decomposition is particularly important in financial studies assessing how investment assets perform under different inflationary pressures.

An asset is considered an inflation hedge if its returns maintain or exceed inflation rates, thereby preserving the real value of capital (Fama & Schwert, 1979). Real estate is often cited as an effective hedge due to its income-generating potential, capital appreciation, and contractual features such as rent escalation clauses. Dabara (2015) emphasized investor preference for real estate due to its perceived ability to protect against the erosive impact of inflation. However, this assumption is not universal. Wolski (2023) supports real estate's hedging role, while Muellbauer (2015) argues that real estate may contribute to inflation, particularly through rising property prices and construction costs. This contradiction highlights the need for empirical evaluation, especially across different asset types, markets, and economic periods.

In developed markets, several studies have tested the inflation-hedging ability of real estate with mixed results. Fehrle (2023), for instance, found that housing offered better hedging capacity than equities, though this effectiveness was time-sensitive. Fang et al. (2022) decomposed inflation into energy, food, and core components and found that traditional inflation hedges, including REITs and commodities, performed well only against energy inflation. Connolly & Stivers (2022) noted that REIT equity returns were strongly influenced by economic cycles, showing poor inflation performance during periods of slow growth or stagflation. National and Low (2000) studied the inflation-hedging characteristics of real estate and financial assets in Singapore, results show that real estate has a better hedge against inflation than stock and real estate securities. (Muckenhaupt et al., 2025a) explored listed real estate as an inflation hedge across regimes, the study examines inflation hedging capabilities of listed real estate in three countries, the US from 1975-2023, Japan and Australia from 1990-

2023 using Markov switching vector error correction models (MS-VECM), results indicate that LRE provides a good hedge against inflation, also, LRE offers a good hedge against expected inflation in the long term and shows a superior hedging ability than stocks.

Muckenhaupt et al. (2025b) studied real estate as an inflation hedge: new evidence from an international analysis, data were compiled from six countries: France, Germany, Sweden, Switzerland, the U.K., and the U.S. using panel Markov switching vector error correction models (MS-VECM), inflation hedging abilities were identified under crises and non-crises periods both in the short and the long term, results have shown that real estate provides an effective hedge against inflation in the long run during crises and non-crises period. In the short run, real estate securities were able to hedge against inflation in stable period, but direct real estate also shows desirable inflation hedging in crisis periods. Real estate (both direct and securitized) effectively serves as a hedge against inflation shocks, particularly protecting against unexpected inflation and against energy inflation during stable periods.

Nasreddine and Zouari (2025) investigated the inflation hedging: a comparative wavelet quantile correlation analysis of real estate and alternative assets, the study employs the wavelet quantile correlation (WQC) methodology and analysis spanning from 2000 to 2023. The findings reveal that French-listed real estate exhibits compelling inflation-hedging characteristics as the investment horizon extends. These findings point to the importance of macroeconomic context and asset sub-class when evaluating hedging performance.

In developing markets, evidence remains limited. Taderera and Akinsomi (2020), studying South African commercial real estate, found that retail and industrial assets hedged inflation in the long run, while office properties did not. Notably, their study highlighted that real estate returns often adjust to inflation with a lag, emphasizing that short-term protection is weaker. These results suggest that the effectiveness of real estate as a hedge depends on both property type and holding period.

Comparative studies on asset classes further complicate the inflation-hedging debate. Gold, oil, stocks, and bonds have historically been analyzed for this purpose (Shahbaz et al., 2014; Ciner, 2015). However, many fail to provide consistent hedging across all inflation components (Spierdijk & Umar, 2015; Hoang et al., 2016). Real estate, due to its real asset nature and income streams, is often viewed as a superior long-term hedge, although its short-run performance remains debated (Salisu et al., 2020). The asset's inflation sensitivity also varies across geographies, economic regimes, and sectors—highlighting the importance of localized research.

The role of real estate in pension fund portfolios has drawn increasing interest globally. Studies such as those by Arnold et al. (2021) and Devine et al. (2023) compared private real estate equity (PERE) and listed REITs, finding comparable long-term performance, though REITs showed better integration of sustainability metrics. In Kenya, Ndung'u and Kung'u, (2022) found that while investor awareness of REITs was high, it had limited impact on performance, suggesting institutional challenges rather than knowledge gaps. In Nigeria, Bernard (2020) and Ibikunle (2022) assessed the potential of pension funds to support real estate development, highlighting positive sentiment but revealing underdeveloped



investment structures. Oigbochie et al. (2023) reported that pension investments had not delivered optimal returns for retirees, indicating misalignment in asset allocation strategies. Bukwimba (2022), in the Tanzanian context, identified real estate as a moderate-risk asset, trailing behind equities and corporate bonds in risk exposure but outperforming in value stability.

Despite increasing interest in real estate as a component of pension fund portfolios, there is a noticeable gap in empirical research assessing its inflation-hedging effectiveness in the Nigerian context. Existing literature either focuses on general real estate performance or macroeconomic correlations without specifically analysing inflation components or economic regime changes. Moreover, most studies lack robust time-series econometric modelling, which is essential for distinguishing short-run fluctuations from long-run trends. This study addresses these gaps by employing both OLS regression and Johansen cointegration techniques to examine the hedging performance of real estate against actual, expected, and unexpected inflation. By further distinguishing between pre-crisis (2008–2015) and crisis (2016–2024) periods, the study aims to provide a nuanced understanding of real estate's role in safeguarding pension assets in Nigeria's volatile macroeconomic environment.

## Methodology

This study adopts a quantitative time-series approach to investigate the inflation-hedging effectiveness of real estate assets within Nigeria's pension fund portfolio. The analysis covers a 17-year period from January 2008 to December 2024, using monthly data (204 observations). The data on real estate and property market values were obtained from the National Pension Commission (PenCom), which provides asset class-level valuation reports for Nigerian pension fund portfolios. Inflation-related variables were derived from the Central Bank of Nigeria (CBN) and the National Bureau of Statistics (NBS). The Consumer Price Index (CPI), sourced from NBS, serves as a proxy for actual inflation, while the 91-day Treasury Bill rate, provided by the CBN, is used to represent expected inflation. Unexpected inflation is computed as the residual difference between actual and expected inflation.

While these institutional data sources are credible and widely used in Nigerian macro-financial research, it is important to note potential limitations such as reporting lags, changes in inflation basket composition, and valuation inconsistencies in illiquid asset classes like real estate. To enhance the interpretability of the time-series data and stabilize variances, all series were transformed using natural logarithms. Log transformations are standard in financial econometrics as they convert percentage changes into additive relationships and reduce the impact of outliers. Furthermore, to ensure the validity of time-series models, Augmented Dickey-Fuller (ADF) tests were employed to determine stationarity. Non-stationary variables at level were differenced once to achieve stationarity before model estimation.

The study divides the sample period into two sub-periods to reflect economic regime changes: pre-economic crisis (2008–2015) and economic crisis (2016–2024). The pre-crisis period is characterized by relatively low and stable inflation, including multiple years of single-digit CPI levels. In contrast, the crisis period reflects high inflation volatility, exchange rate devaluation, and the removal of fuel subsidies. This sub-perioding aligns with approaches used in related studies (e.g., Le Moigne & Viveiros, 2008; Erol & Tirtiroglu, 2008) and enables a more granular examination of hedging dynamics under different macroeconomic environments. To evaluate the inflation-hedging performance of real estate assets, two econometric techniques were applied: Ordinary Least Squares (OLS) regression was used to estimate the short-run relationship between real estate returns and the components of inflation, based on the Fama & Schwer (1977) framework:

$$R_t = \alpha + \beta E(\Delta t) + \gamma [\Delta t - E(\Delta t)] + \varepsilon_t$$

Where:

- $R_t$  : Return on real estate asset at time  $t$
- $E(\Delta t)$  : Expected inflation
- $\Delta t - E(\Delta t)$  : Unexpected inflation
- $\beta, \gamma$  : Coefficients capturing sensitivity to expected and unexpected inflation, respectively
- $\varepsilon_t$  : Error term

The OLS model provides an interpretable estimate of the degree of hedging offered by real estate. Hedge classifications follow the framework by Wahab et al. (2018) and Nwosu et al. (2023), categorizing outcomes as complete, partial, perverse, or no hedge based on the significance and sign of the inflation coefficients. However, OLS regression is limited to short-run dynamics and may suffer from endogeneity and omitted variable bias. To address this, we checked for multicollinearity using Variance Inflation Factors (VIFs), and conducted robustness checks where needed. Nonetheless, because OLS does not capture long-term equilibrium relationships, it is complemented by a more robust cointegration analysis.

Johansen Cointegration Test, developed by Johansen and Juselius (1990) was employed to assess the long-run relationship between real estate capital returns and inflation components. Unlike Vector Error Correction Models (VECM), which require prior knowledge of cointegration, the Johansen procedure identifies multiple cointegrating vectors and is suitable for multivariate systems. Compared to ARDL models—which are best suited for mixed-order integration ( $I(0)$  and  $I(1)$ )—Johansen’s method is more appropriate for this study, given that all series were confirmed to be integrated of the same order ( $I(1)$ ) after differencing. This methodological choice aligns with prior studies in similar contexts (e.g., Lee, 2021; Ekemode, 2021; Wolski,

2022). In both models, economic inferences are drawn not only from statistical significance but also from economic interpretation which evaluating whether real estate returns adjust adequately to offset inflation losses in real terms. Overall, this combined short- and long-run approach allows for a comprehensive assessment of real estate's inflation-hedging capability across varying inflation environments in Nigeria's evolving macroeconomic landscape.

## Results And Discussion

The analysis and presentation of results are categorized into five sections. The first section presents data on the three measures of inflation—actual, expected, and unexpected—in order to explain how unexpected inflation was derived. It also illustrates how inflation rates relate to the classification of pre-economic crisis and economic crisis periods. The second section provides descriptive statistics for real estate and property returns, along with the three inflation components. The third section highlights the short-run inflation-hedging potential of real estate and property in the Nigerian pension fund, using Ordinary Least Squares (OLS) regression analysis. The fourth section presents the stationarity tests conducted using the Augmented Dickey-Fuller (ADF) test. Finally, the fifth section reports the results of the Johansen cointegration test, which was used to examine the long-run equilibrium relationship between real estate returns and the three inflation measures.

### Actual, Expected and Unexpected Inflation Measures

The analysis and findings are organized into five key sections. The first outlines the inflation metrics used (actual, expected, and unexpected inflation), offering a basis for the construction of the inflation components and their behaviour over distinct macroeconomic periods. The second section provides descriptive statistics of real estate and inflation components to characterize distributional behaviour. The third section presents unit root testing using the Augmented Dickey-Fuller method. The fourth explores short-run inflation-hedging dynamics using OLS regression and the fifth assesses long-run cointegration using the Johansen technique.

Table 1 displays inflation data categorized into pre-economic crisis (2008–2015) and economic crisis (2016–2024) phases. The 204 monthly observations (2008-2024) obtained were converted to annual observations using average figures for each year under consideration, this was done in order to have a better and precise capture of all the economic activities that leads to the categorization into different economic cycles. The pre-crisis period exhibits relatively stable inflation, while the crisis phase features high inflation volatility, currency devaluation, and economic disruptions due to policy shifts such as fuel subsidy removal. For example, actual inflation rose from 9.02% in 2015 to 15.63% in 2016, peaking at 34.80% in 2024. The calculation of unexpected inflation (actual minus expected) provides insight into inflation shocks beyond market expectations.



**Table 1: Inflation Rates and Economic Cycle in Nigeria**

Year	Actual Inflation	Expected Inflation	Unexpected Inflation	Economic Status	Economic Activities
2008	11.53	8.20	3.33	Pre-Economic Crisis (2008-2015)	Stable inflation rates including single digit inflation rates for 3 years
2009	12.90	3.79	9.11		
2010	13.76	3.85	9.91		
2011	10.58	9.70	0.88		
2012	12.24	13.64	-1.40		
2013	8.52	10.85	-2.33		
2014	8.06	10.50	-2.44		
2015	9.02	9.39	-0.37		
2016	15.63	10.12	5.51	Economic Crisis (2016-2024)	High inflation rates, Devaluation of currency, Removal of fuel subsidy. (CBN, 2025)
2017	17.07	15.92	1.15		
2018	12.09	11.84	0.25		
2019	11.39	10.42	0.97		
2020	13.25	2.39	10.86		
2021	16.91	2.00	14.91		
2022	18.77	9.75	9.02		
2023	24.52	12.15	12.37		
2024	34.80	18.50	16.30		

(CBN, 2008-2024; NBS, 2008-2024)

### Descriptive Statistics of Real Estate and Property and Inflation Measures

Descriptive statistics (Table 2) reveal that actual inflation has the highest mean value (2.61), followed by real estate and property (2.28). Unexpected inflation is the most volatile variable (std. dev. = 1.33). The real estate return distribution shows mild left-skewness (-0.14), suggesting a near-normal pattern. This variability is important for fund managers in anticipating downside risks.

**Table 2: Descriptive Statistics of Real Estate and Property and Inflation Measures**

Variable	Mean	Std. D.	Min.	Max	Skewness	Kurtosis
Real Estate & Property	2.28	0.64	1.20	3.41	-0.14	2.24
Actual Inflation	2.61	0.36	2.08	3.47	0.70	3.14
Expected Inflation	2.10	0.64	0.69	2.91	-1.07	2.98
Unexpected Inflation	1.41	1.33	-1.38	2.70	-0.84	2.37

Source: Authors' Compilation (2025)

### Unit Root Test

The results of the unit root tests using the Augmented Dickey-Fuller (ADF) approach (Tables 3 and 4) reveal that all variables—real estate returns, actual inflation, expected inflation, and unexpected inflation—are non-stationary in their level forms but become stationary after first differencing. This confirms that the data series are integrated of order one,  $I(1)$ , a necessary condition for applying the Johansen cointegration technique. The transformation addresses potential issues of spurious regression and validates the methodological foundation for long-run equilibrium analysis.

**Table 3: Augmented Dickey Fuller Unit Root Test at level**

Variable	Option	t-statistics	p-value	Status
Real Estate & Property	level	1.10	0.99	Non-Stationary
	Trend & intercept	-0.10	0.99	Non-Stationary
Actual Inflation	level	-0.60	0.86	Non-Stationary
	Trend & intercept	-1.65	0.76	Non-Stationary
Expected Inflation	level	-1.90	0.33	Non-Stationary
	Trend & intercept	-1.97	0.61	Non-Stationary
Unexpected Inflation	level	0.80	0.99	Non-Stationary
	level & intercept	0.66	0.99	Non-Stationary

Authors Compilation, 2025.

**Table 4: Augmented Dickey Fuller Unit Root Using 1<sup>st</sup> Difference**

Variable	Differencing	t-statistics	p-value	Status
Real Estate and Property	1 <sup>st</sup> difference	-17.69	0.00	Stationary
Actual Inflation	1 <sup>st</sup> difference	-7.14	0.00	Stationary
Expected Inflation	1 <sup>st</sup> difference	-14.13	0.00	Stationary
Unexpected Inflation	1 <sup>st</sup> difference	-5.20	0.00	Stationary

Authors Compilation, 2025.

### OLS Regression; Short run inflation hedging potentials of real estate and property

The Ordinary Least Squares (OLS) regression results presented in Table 4 provide valuable insights into the inflation-hedging performance of real estate assets across three distinct economic phases. For the full study period (2008–2024), real estate demonstrated robust inflation-hedging capability against both actual inflation ( $\beta = 0.85$ ) and expected inflation ( $\beta = 0.75$ ), with both coefficients statistically significant at conventional levels. These results indicate that, over the long horizon, real estate investments have effectively preserved purchasing power in line with both realized and anticipated inflationary trends. However, the hedge against unexpected inflation—measured by a comparatively low coefficient of  $\beta = 0.11$ —was only partial. This suggests that real estate returns are less responsive to inflationary shocks that deviate from market expectations, highlighting a degree of exposure to macroeconomic volatility and unanticipated disruptions.

In contrast, during the pre-economic crisis period (2008–2015), the hedging performance of real estate weakens markedly. The OLS results reveal a negative relationship between real estate returns and both actual inflation ( $\beta = -0.93$ ) and unexpected inflation ( $\beta = -0.08$ ), indicating a perverse hedge in both cases. Such a result implies that, rather than offsetting the erosive effects of inflation, real estate returns moved inversely to inflationary pressures during this relatively stable period. This counterintuitive performance may reflect lag effects in institutional investment reactions, pricing rigidities in the property market, or regulatory and liquidity constraints within the Nigerian pension system during periods of moderate or controlled inflation. Interestingly, only expected inflation produced a positive, albeit partial, hedge ( $\beta = 0.37$ ), suggesting some alignment between market forecasts and asset performance, albeit insufficient for full inflation protection.

During the economic crisis period (2016–2024), which was marked by currency devaluation, removal of fuel subsidies, and persistent inflationary surges, the inflation-hedging capability

of real estate appears to recover. The  $\beta$  coefficient for actual inflation (0.75) once again crosses the threshold for a complete hedge, reaffirming real estate's utility in protecting capital against nominal price increases during turbulent periods. The response to unexpected inflation also improves ( $\beta = 0.15$ ), indicating a moderate level of resilience to inflationary surprises. However, the hedge against expected inflation during this period is negligible and statistically insignificant ( $\beta = 0.0381$ ,  $p > 0.05$ ), suggesting a breakdown in the ability of market expectations to capture inflationary pressures effectively during times of heightened uncertainty. This points to a broader issue: when macroeconomic volatility intensifies, expectations may no longer be reliable predictors, and real estate may not adjust in anticipation but rather in reaction to inflation shocks.

This study revisits the conventional threshold values for interpreting  $\beta$  coefficients, traditionally guided by Wahab et al. (2018). While previous studies have loosely classified  $\beta \geq 1$  as a complete hedge, this analysis adopts more context-sensitive thresholds:  $\beta \geq 0.7$  is interpreted as a complete hedge, values between 0.3 and 0.7 as a partial hedge,  $\beta \approx 0$  as no hedge, and negative values as perverse hedges. These adjusted benchmarks provide a more nuanced framework that better reflects asset behaviours in real-world economic contexts, especially in emerging markets like Nigeria where structural volatility and policy shocks are common.

The policy and investment implications of these findings are significant. Pension fund managers and institutional investors must recognize the time-varying nature of real estate's inflation-hedging effectiveness. In relatively stable macroeconomic periods, real estate may underperform as a hedge or even exhibit adverse responses to inflation. However, in inflationary or crisis-prone environments, the asset class appears to regain its hedging capacity. Therefore, strategic asset allocation must be dynamic—funds should increase their exposure to real estate during inflationary spikes but consider complementing it with assets such as Treasury Inflation-Protected Securities (TIPS), commodities, or infrastructure investments that provide broader and more reactive inflation coverage. Furthermore, overreliance on expected inflation as a guide for portfolio decisions could be misleading, particularly in economies where inflation is frequently driven by policy shocks or supply-side disruptions that evade conventional forecasting models.

Ultimately, this analysis underscores the importance of inflation-hedging diversification within pension portfolios and calls for adaptive investment strategies informed by the economic regime and the nature of inflationary pressures.

**Table 5: Inflation Hedging Potential of Real Estate**

Type of Inflation	Beta	Std. Error	R-Square	t-stat	P-Value	Type of Hedge
<b>2008-2024</b>						
Actual Inflation	0.85	0.06	0.42	12.27	0.00	Complete Hedge
Expected Inflation	0.75	0.05	0.22	10.25	0.00	Complete Hedge
Unexpected Inflation	0.11	0.03	0.07	3.38	0.00	Partial Hedge
<b>2008-2015</b>						
Actual Inflation	-0.93	0.10	0.47	-9.15	0.00	Perverse Hedge
Expected Inflation	0.37	0.04	0.38	7.68	0.00	Partial Hedge
Unexpected Inflation	-0.08	0.01	0.35	-4.99	0.00	Perverse Hedge
<b>2016-2024</b>						
Actual Inflation	0.75	0.05	0.63	13.48	0.00	Complete Hedge
Expected Inflation	0.03	0.04	0.00	0.94	0.34	Partial Hedge
Unexpected Inflation	0.15	0.01	0.38	7.62	0.00	Partial Hedge

Authors Compilation, 2025.

### **Johansen Cointegration test.**

To overcome the limitations of the Fama and Schwert (1977) Ordinary Least Squares (OLS) methodology—which primarily captures short-term inflation-hedging dynamics—this study adopts the Johansen cointegration framework (Johansen & Juselius, 1990) to investigate the existence of long-run equilibrium relationships between real estate returns and three measures of inflation: actual, expected, and unexpected. Unlike OLS, which is susceptible to spurious correlations when variables are non-stationary, the Johansen technique provides a more robust and statistically grounded approach for evaluating whether these variables co-move over time. This is particularly relevant for long-term institutional investors such as pension funds, which must account for inflation risks that persist across economic cycles.

The cointegration results, presented in Table 6, reveal compelling evidence of stable long-term relationships between real estate returns and all inflation measures across the entire sample period (2008–2024), the pre-crisis period (2008–2015), and the economic crisis period (2016–2024). In each sub-period and for all inflation components, both the trace statistics and maximum eigenvalue statistics exceed their respective 5% critical values. Moreover, the associated p-values are consistently below the 0.05 threshold, leading to the rejection of the null hypothesis of no cointegration ( $r = 0$ ). These findings confirm the existence of at least one statistically significant cointegrating vector in each scenario.

The consistent presence of cointegration implies that although real estate returns may not respond immediately to inflation shocks—particularly unanticipated ones—they do adjust in the long term. This long-run alignment suggests that real estate serves as an effective inflation hedge over extended horizons. Both expected and unexpected inflation are eventually reflected in asset price movements, highlighting the asset's strategic value in preserving purchasing power in real terms. Importantly, this relationship holds across differing economic conditions, from relatively stable periods to times of heightened macroeconomic volatility, reinforcing the structural nature of the linkage.

This robustness across economic regimes enhances the credibility of real estate as a dependable inflation hedge in long-duration portfolios. For pension fund managers, this suggests that strategic allocations to real estate can help mitigate long-term inflation risk, even if short-term deviations occasionally occur. Notably, these findings mirror the results of previous studies. Ekemode (2021) documented similar cointegration between residential real estate and inflation in the Nigerian context, while Lee (2021) found long-run inflation-hedging behavior in real estate markets across China, India, and Russia. Additionally, Inglesi-Lotz and Gupta (2013) observed cointegration between multiple real estate segments and inflation in South Africa. Together, this growing body of empirical evidence affirms real estate's role as a critical component in inflation-sensitive investment strategies, particularly in emerging economies where inflation remains both persistent and policy-sensitive.

**Table 6: Cointegration Test Between Real Estate and Inflation**

Variable	Trace Statistics	Critical Value	Max-Eigen Statistics	Critical Value	P-value
<b>2008-2024</b>					
Actual Inflation	49.88	15.49	49.87	14.26	0.00
Expected Inflation	38.41	15.49	36.53	14.26	0.00
Unexpected Inflation	47.15	15.49	45.17	14.26	0.00
<b>2008-2015</b>					
Actual Inflation	44.90	15.49	40.66	14.26	0.00
Expected Inflation	43.10	15.49	41.25	14.26	0.00
Unexpected Inflation	44.63	15.49	42.92	14.26	0.00
<b>2016-2024</b>					
Actual Inflation	22.84	15.49	21.10	14.26	0.00
Expected Inflation	22.25	15.49	19.91	14.26	0.00
Unexpected Inflation	21.75	15.49	20.39	14.26	0.00

Authors Compilation, 2025.

The overall findings from this study reveal that Nigerian real estate exhibits mixed inflation-hedging characteristics in the short run but demonstrates strong and consistent alignment with inflation measures in the long run. The OLS regression results show that while real estate provides a complete hedge against actual and expected inflation over the full sample period (2008–2024), it only partially hedges against unexpected inflation. During the pre-crisis period (2008–2015), real estate displayed a perverse hedge against actual and unexpected inflation, likely due to rigid pricing structures and slower market responsiveness in low-inflation environments. However, this performance improved during the economic crisis period (2016–2024), where real estate again served as a complete hedge against actual inflation and a partial hedge against unexpected shocks. These outcomes suggest that inflation-hedging performance is context-dependent, varying across macroeconomic conditions.

The Johansen cointegration analysis reinforces these insights by confirming a stable long-run equilibrium relationship between real estate returns and all three inflation measures across different economic cycles. The robustness of this long-term relationship, even during Nigeria's volatile inflationary periods, highlights the structural capacity of real estate to adjust and align with inflation trends over time. These findings carry significant implications for the Nigerian pension fund industry. Given the persistent inflationary pressures and structural



reforms affecting Nigeria's economy, pension fund managers should prioritize real estate as a long-duration hedge. The evidence supports the strategic inclusion of property assets in pension portfolios as a means of safeguarding retirement savings against long-term purchasing power erosion, ensuring more resilient and inflation-protected investment outcomes for contributors.

## Conclusion

This study investigated the inflation-hedging potential of real estate securities within a mixed-asset portfolio of the Nigerian pension fund, using monthly data from the National Pension Commission spanning from 2008 to 2024. Employing both Ordinary Least Squares (OLS) regression and Johansen cointegration techniques, the study analyzed how real estate responds to actual, expected, and unexpected inflation across different economic phases. The results show that real estate has served as an effective hedge—particularly during high-inflation periods (2016–2024)—offering protection against actual inflation and partially mitigating unexpected shocks. Furthermore, the Johansen cointegration results confirmed a stable long-run equilibrium relationship between real estate returns and all measures of inflation, reinforcing the asset's strategic value for long-duration portfolios such as pension funds.

Therefore, this study emphasizes the importance of adopting a long-term perspective when evaluating inflation hedging strategies within pension fund portfolios. Fund managers should be cautious in interpreting short-run deviations and instead anchor their strategic decisions on the more reliable long-run equilibrium behavior of real estate in relation to inflation. This approach can help ensure the preservation of real wealth and contribute to more resilient and sustainable pension systems in inflation-prone economies like Nigeria.

The practical implications of these findings are significant. Real estate is considered a valuable asset for pension fund portfolio by offering hedge against inflation. The inclusion of real estate in a mixed asset portfolio enhances stability in the long term, diversification benefits and resilience in inflationary market to the pension funds. Moreover, this can serve as a guidance to pension funds in allocating resources to real estate since it has shown evidence of both short and long run inflation hedging potential. For pension fund administrators and regulators like the National Pension Commission, the results provide empirical evidence to support increased allocation to real estate within the pension portfolio, especially during periods of high inflation and economic volatility. Fund managers can use these insights to rebalance asset allocations, prioritizing inflation-resilient assets like real estate to protect the purchasing power of contributors' retirement savings. Additionally, institutional investors—including insurance companies, real estate investment trusts (REITs), and property developers—can use the results to justify long-term real estate investments as part of broader inflation-risk mitigation strategies. The study also serves as a forecasting guide, enabling investment decision-makers to anticipate how real estate may respond under future inflationary trends. Finally, professionals in the real estate sector can leverage these findings to advocate for more active integration of property assets into institutional portfolios, enhancing their role as a stabilizing asset class in Nigeria's inflation-sensitive economy.

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