

PENSION FUND INVESTMENT STRATEGIES AND INFRASTRUCTURE FINANCING IN NIGERIA

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Abstract

This study examines the effectiveness of pension fund investment strategies in facilitating infrastructure financing in Nigeria. It explores several key investment vehicles, including Public-Private Partnerships (PPP), housing project financing, infrastructural bonds, co-investment, and direct infrastructural funding. The data were collected from secondary sources, including reports and databases from PenCom, the National Bureau of Statistics, the Debt Management Office, and other financial institutions. STATA software was used to analyze the data and draw conclusions. The findings indicate that PPP, housing project financing, and infrastructural bonds have a negative and insignificant relationship with infrastructure financing, suggesting that these strategies do not significantly contribute to infrastructure development in Nigeria. These results contradict some prior studies as stated in the interpretation of findings, while aligning with the findings of other studies. In contrast, co-investment demonstrates a positive and significant relationship with infrastructure financing, highlighting its potential as an effective strategy for mobilizing pension funds toward infrastructure projects. Overall, the study suggests that while certain investment strategies may not currently be effective in driving infrastructure financing, co-investment holds promise for enhancing the role of pension funds in Nigeria's infrastructure development.

Keywords: PFA Strategies, Infrastructural financing, Co-investment, infrastructural bonds, Infrastructural funds

1. Introduction

Infrastructure development is crucial for sustainable economic growth, poverty alleviation, and job creation (Ogunlana et al., 2023). However, Nigeria has faced persistent infrastructure deficits across various sectors, such as transportation, energy, and housing, which have hindered economic development as reported by Ogunlana et al. (2023). Traditional funding sources for infrastructure, such as government budgets and loans from international financial institutions, have often proven inadequate (Augustine, 2023). This has raised the question of whether pension funds could be a viable alternative source of financing for infrastructure projects in Nigeria.

Pension funds are a major source of long-term capital for economies worldwide (Agranov & Palfrey, 2023). In Nigeria, the pension sector has witnessed considerable growth since the enactment of the Pension Reform Act (PRA) in 2004, which established a contributory pension scheme aimed at providing retirement benefits to workers in both the public and private sectors. As of 2022, the Nigerian pension industry manages over N13 trillion in assets, which represents a significant pool of funds that could potentially be channeled into the development of the country's infrastructure (Paklina & Stanko, 2021; Agwanda, 2019; Okwoche & Makanza, 2023).

The major objective of this paper is to examine the relationship between pension funds investment strategies and infrastructure financing in Nigeria. The specific objectives are as follows:

- i) Examine the effect of private-public partnerships on infrastructure financing in Nigeria.
- ii) Assess the effect of housing project financing (real estate) on infrastructure financing in Nigeria.
- iii) Evaluate the effect of infrastructural bonds on infrastructure financing in Nigeria.
- iv) Explore the effect of co-investment strategies on infrastructure financing in Nigeria.
- v) Investigate the effect of infrastructural fund on infrastructure financing in Nigeria.

This study spans the period from 2004 to 2023 and focuses on how pension funds in Nigeria can contribute to infrastructure financing through private-public partnerships, housing project financing, infrastructure bonds, co-investment strategies, and infrastructure funds. It evaluates pension fund investments in infrastructure projects to measure their impact on the sector.

The study is significant in several areas: it highlights the potential for pension funds to drive economic development by improving infrastructure, addresses Nigeria's infrastructure deficit, and explores sustainable long-term investment opportunities. The research also aims to enhance the financial markets by promoting liquidity, diversification, and innovation, while providing insights into the regulatory framework needed to support infrastructure investments. Additionally, it considers the social and environmental impacts of such investments, including their role in improving communities and supporting sustainable development. The study aims to contribute to knowledge sharing and collaboration among stakeholders in infrastructure financing.

2. Literature Review

This section explains the major subject matter that relates to the key terminologies.

2.1 Conceptual Review

2.1.1 Pension Funds Investment Strategies and Infrastructure Finance in Nigeria

The contributory pension scheme came into operation in Nigeria in 2004, following the enactment of the Pension Reform Act of 2004 (as amended in 2014) which allowed for the establishment of the contributory pension funds custodians and administrators. This has led to a remarkable shift towards funding and private sector management of pension funds and rapid growth in pension funds. Modalities for leveraging on the tremendous growth in pension funds to finance infrastructure projects in Nigeria have been an issue of great concern. The long-term nature of Pension Fund Management, however, makes it seem to be a feasible alternative source for infrastructure funding. In many countries of the world, pension funds are the main institutional investors, and these financial institutions invest very large amounts of financial assets in infrastructure.

While section 87 (1) provides that, a pension fund administrator may invest the pension funds in units of any investment outside Nigeria within the categories of investments set out in section 86 of this act. Various regulations, guidelines, rules, and circulars are issued by the regulatory institution, Pension Commission in addition to the provisions of the Pension Act 2014 stated above, while safeguarding such funds from unscrupulous fund managers, an over-regulated pension market like Nigeria cannot be effectively tapped for national development as is the current situation in which pension funds contribution to infrastructure development is abysmal. An analysis of Nigeria Pension Commission and Pension Fund administrators' monthly, quarterly, and annual reports for the period up to January 2022 indicates some of the strategies adopted to invest pension funds in infrastructure projects include the following:

2.1.2 Infrastructure Bonds and infrastructure finance in Nigeria

According to Park et al. (2022) Infrastructure bonds are debt securities issued by government or private entities to raise capital for the development of infrastructure projects. These bonds typically have a long maturity period and the proceeds are used to fund various infrastructure initiatives such as road construction, energy projects, water supply, and communication networks. They are a key instrument in infrastructure financing as they provide a stable and predictable source of capital for large-scale projects (Adebayo & Uche, 2023).

Pension funds are naturally inclined to invest in bonds because they offer relatively stable returns with lower risk compared to equities (Adekoya, 2023). For pension funds in Nigeria, infrastructure bonds provide a unique opportunity to meet their long-term investment goals while supporting national development. By investing in such bonds, pension funds can diversify their portfolios while contributing to vital infrastructure projects (Mundonde & Mokoni, 2024).

Ebere (2021) opined that the Nigerian government have utilized infrastructure bonds as a primary vehicle for financing key projects. The most notable example is the Federal Government of Nigeria's (FGN) Infrastructure Bond, which was introduced to fund transportation and energy infrastructure projects. In the past decade, Nigeria has also seen the development of state-level infrastructure bonds, such as the Lagos State Infrastructure Bond, aimed at addressing critical urban infrastructure needs.

In addition to government-issued bonds, private sector entities have increasingly issued bonds for infrastructure projects (Augustine, 2023). These include energy companies, toll road operators, and telecommunications firms looking to raise funds for infrastructure expansion.

2.1.3 Infrastructure funds and infrastructure finance in Nigeria

Infrastructure funds are pooled investment vehicles that focus specifically on infrastructure assets (Roseline & Ojuolape, 2020). These funds typically invest in large-scale projects across various sectors, such as transportation (roads, bridges, airports), energy (power plants, renewable energy), water and sanitation, and telecommunications. Infrastructure funds have gained popularity globally, as institutional investors seek to allocate capital to stable, long-term assets that can offer inflation-linked returns and diversification (Tule et al., 2022). These are specialized infrastructure funds that focus on financing infrastructure projects across various sectors such as transportation, energy, telecommunication, etc.

In Nigeria, infrastructure funds are primarily designed to enable pension funds and other institutional investors to access infrastructure projects without directly owning the assets. These funds may be managed by private equity firms, asset managers, or sovereign wealth funds, pooling resources from multiple investors to finance diverse projects.

According Augustine (2023) the notable infrastructure funds in Nigeria include the Nigeria Infrastructure Fund (NIF), launched to attract both domestic and international investment for the country's infrastructure needs.

2.1.4 Co-investments and infrastructure finance in Nigeria

Okwoche and Makanza (2023) explained co-investment as a collaborative investment approach where pension funds and other institutional investors, such as private equity firms, sovereign wealth funds, or infrastructure developers, jointly invest in a specific infrastructure project. This strategy allows pension funds to share risks and rewards with other investors, benefiting from the expertise and resources of more experienced partners while accessing larger-scale projects (Roseline & Ojuolape, 2020).

The main benefits of co-investment strategies are enhanced diversification, reduced risk, and access to larger projects that may be out of reach for individual pension funds.

2.1.5 Housing Project financing or real estate and infrastructure finance in Nigeria

Roseline and Ojuolape (2020) defined housing project financing as an investment in residential and commercial real estate usually through direct ownership or indirect investment via real estate funds or bonds. In many emerging markets, including Nigeria, the demand for affordable housing and real estate development is high, making it a natural area for pension funds to invest.

According to Okwoche and Makanza (2023) the real estate investments, especially housing projects, offer pension funds a way to contribute to national infrastructure development while achieving steady, long-term returns. Given Nigeria's large and growing population, there is significant demand for housing, which presents a promising investment opportunity. Real estate assets typically offer pension funds an inflation-hedged investment with stable income streams from rental returns or capital appreciation from property sales.

Pension funds in Nigeria can invest in housing projects either directly by financing large residential developments or indirectly through real estate investment trusts (REITs) or specialized property funds. The Federal Government's Mass Housing Scheme and state-level affordable housing projects have attracted the interest of institutional investors, including pension funds (Okwoche & Makanza 2023).

2.1.6 Public-Private Partnerships (PPP) and infrastructure finance in Nigeria

Public-Private Partnerships (PPPs) are contractual agreements between the government and private entities, including pension fund to finance and manage infrastructure projects (Roseline & Ojuolape, 2020). In a PPP according to Adekoya (2023), the private sector typically provides the capital and expertise, while the public sector offers regulatory support and a guaranteed return on investment. PPPs are becoming increasingly popular in Nigeria as a means to address the country's infrastructure deficit. Through PPPs, the government can leverage private capital to fund critical projects without bearing the entire financial burden. Pension funds are

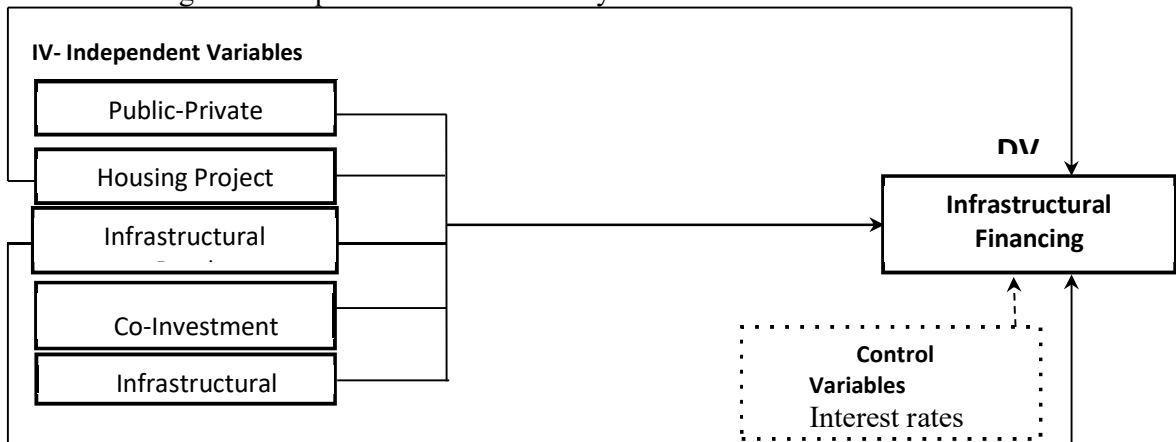
key players in these partnerships, as they provide the long-term capital needed for infrastructure development (Okwoche & Makanza, 2023).

Examples of successful PPPs in Nigeria include the Lekki Toll Road, the Lagos-Ibadan Expressway and the Abuja Light Rail, where pension funds, through investment vehicles or direct participation, have provided financing. The Nigerian government has also established frameworks, such as the Infrastructure Concession Regulatory Commission (ICRC), to facilitate PPPs and ensure that pension funds can invest in a manner that aligns with their risk-return profiles. In Nigeria, generally, Infrastructure financing and development have always been subsumed in the country’s vision and development plans mainly financed by the Government through annual capital budgets (Adekoya, 2023). A clear-cut, national infrastructure development plan and strategy leveraging pension funds and mining tax (such as crude oil and LNG) is required if meaningful progress is to be made in this direction. As observed in other countries, the substantial financial resources required to close the infrastructure gap, and maintain and add to existing infrastructure, calls for a comprehensive strategic review of the funding of infrastructure assets in Nigeria. Increasingly, there is an urgent need to tie the funding of such assets with appropriate instruments and commercial arrangements, particularly from the private sector; this could be driven through Public Private Partnerships (PPP).

Drawing from the reviewed country experiences, there is a need to consider issuing infrastructure bonds, with strong ratings premised on strong project analysis and competencies, and good prospects for repayment on PPP projects. This could be used to finance fee-paying and toll-collecting projects such as refineries, roads, hospitals, bridges, and transportation infrastructures among others.

2.2 Conceptual Framework

This is the diagrammatic presentation of the study variables.



Source: Roseline and Ojuolape (2020) (Modified)

2.3 Empirical Review

Several studies have been reviewed on the relationship that exists between Infrastructure deficit and pension assets and Public Private Partnership (PPP) which pension funds administrators also use as a means to finance projects, both internationally and locally. Some researchers posited that such an alternative source of funding could provide long-term financing for infrastructural development (Ogunlana

et al, 2023). However, several other scholars have examined the significance of pension funds to infrastructural development.

Alexander et al. (2023) examined the increasing importance of alternative investment especially pension funds in financing infrastructure projects due to its performance as the best-performing asset class as measured by net returns. The study focused on pension funds allocation to infrastructure, using the CEM benchmarking databases. The study observed significant scale advantages in infrastructure investments, with larger pension funds exhibiting lower investment costs and higher net returns.

Ebere (2021) in his study on pension funds' investment in Real Estate argued that investing in alternative assets (property) also involves new types of investment vehicles and risks such as exposure to leverage, legal and ownership issues, environmental risks as well as regulatory and political challenges and that if Governments wish to assist infrastructure developers to tap into potentially important sources of financing such as pension funds, certain steps must be taken.

Braknia and Abderrazek (2023) studied the role of pension funds in financing infrastructure projects. They used a descriptive approach and touched on the experiences of other Countries that used pension funds in financing infrastructure in their respective countries and globally. They argued that due to the huge volume of pension funds and large spending on infrastructure

Project financing, this model can be applied in many countries because pension funds are global and available in most countries of the world.

Roseline and Ojuolape (2020) Examined Pension Fund Assets (PFA) and Infrastructural Financing (INFF) in Nigeria. The Generalized Methods of Moment was used to analyze secondary data of Pension Fund Administrators. The findings show that PFA has a positive and significant effect on INFF. GDP and PFA ratio were found significant in INFF positively and Capital expenditure and PFA ratio had a positive and significant effect on INFF. Inflation, however, has a negative and significant effect on INFF. The paper recommends PFA as an alternative source of INFF provided measures are taken to prevent its abuse.

Adekoya (2023) examined pension funds as alternative sources of finance for infrastructural development in Nigeria. The study employed an exploratory research design with a focus on literature on the field of accounting and finance relating to the topic. The study concluded that in Nigeria, the private sector participation in ID had been very low. However, there is a need for the government to guarantee infrastructure bonds along with tax incentives provided for Pension Fund Administrators. The regulatory agencies should be fair and transparent in overseeing project implementation. Governments should help infrastructure developers tap into pension funds through an upward review of the percentage of total assets funded for ID.

Mundonde and Mokoni (2024), in a study on a framework model for financing sustainable water and sanitation infrastructure in Zimbabwe, employed the Tobit econometric model on data collected from both domestic and international data banks over a 25-year period (1998- 2023). They developed and recommended a financing framework for water and sanitation PPP infrastructure projects in the country and developing countries as a whole.

In another study, Kapesa. et al. (2022) examined present and future innovative finance in mitigating the public infrastructure gap in Zimbabwe using descriptive research

methods in which data were collected from 23 interviews and 32 questionnaires. It revealed that the country does not utilize innovative, conventional infrastructure financing methods such as public-private partnership (PPP) due to its regulatory and legal deficiencies and, therefore, requires improvement.

Kashyap and Sharma (2024) reviewed project financing through the use of infrastructure investment trust, structured finance, private equity, public offerings and the emergence of PPP as a viable tool for real estate financing in India. The research review used doctrinal legal research methods and concluded that little result was achieved due to their unpopularity as financing methods.

Chan et al. (2023) studied barriers to attracting private sector investment in Iranian public road infrastructure projects using a descriptive survey approach and employing three- round Delphi technique with 35 experts from both public and private sectors of Iran. The result showed four (4) main groups of legal and organizational, political, economic, and operational barriers to be significantly impacting the attraction of private sector investments in projects such as this.

In South Korea where infrastructure is relatively advanced compared to Sub- Saharan Africa, the need to source for a more inclusive infrastructure financing model was recommended by Park et al. (2022). The research proposes an infrastructure financing model which tokenizes infrastructural assets in which institutional and individual investors can invest and trade tokens easily. This model lowers the barrier through tokenization of infrastructural assets in which retail investors can directly invest, thus giving project owners opportunities to attract funds from many sources thereby lowering the cost of financing.

Niaman and Aslam (2023), in a study which utilized qualitative approach using document analysis method as a collection tool, looked at Islamic finance as an alternative source of financing infrastructure as against other conventional financing mechanisms. They conclude that PPP method of financing infrastructure is congruent to Islamic finance, as financiers, they also participate in risk sharing as other participants in the project.

Mmadi (2023), in a study aimed at enhancing road infrastructure financing in Malawi, critically analysed the effectiveness of the country's road funding model and proposed a sustainable and innovative model for improving its financing. The study utilizes the mixed- methods approach by combining quantitative and qualitative research techniques. It employs surveys and interviews to assess current road conditions from stakeholders and budgetary evaluations and interviews of experts to analyse financial dynamics and governance aspects of roads in Malawi.

The evaluation results highlighted a significant perception gap between desired and actual infrastructure quality, with stakeholders rating road condition as poor. The study recommends the integration of PPP in order to leverage private investment thereby reducing fiscal burden on the Government and a dedicated road fund into which multiple revenue streams such as fuel tax, toll collections and international donor funds could be utilized to stabilize funding sources.

Zhang et al. (2020) in a study which looked at a System Dynamic (SD) simulation model for financing strategy management of infrastructure PPP projects. It looked at this model in order to analyse the impact of financing strategies on the need of creditors, Government, and private investors considering the complex and dynamic

nature of PPP projects as it relates to Highways. The outcome of the experiment conducted over a 33-year period in order to assess the strategic planning for assessing effects of different financing strategies. The results reveal that the model is a useful tool that could support decision makers in identifying intervals with varying management of financing risk and choosing optimal financing strategies from the mix. The study concluded that the Government should select a financing strategy for infrastructure using PPP with capital limitations.

Onwuka and Nwafor (2023) examine Tackling Infrastructural Gap in Nigeria: The Pension Fund Option. The study reviewed the prospect of using the hugely untapped pension funds to bridge infrastructure financing gaps in Nigeria. Infrastructure financing is estimated to cost Nigeria a total investment of USD 2.9 trillion over the next 30 years to bring it to a level that can be competitive and self-sustaining. This huge investment outlay is clearly beyond the yearly fiscal operations of the government. However, there is a glimmer of hope by way of pension funds, which as of August 2016, is over N5.9 trillion and an outstanding N19.531 trillion as of January 2022.

This phenomenal growth in pension funds presents a rare opportunity to bridge the nation's current infrastructure gap by leveraging part of the huge pension assets for developmental purposes. The authors argued that there is a need to review the regulatory and institutional framework in pension funds administration to make way for the creative use of some of the pension funds to fund infrastructure, creating a veritable profitable investment outlay for the pension funds contributors and at the same time providing the needed funding for critical infrastructure financing in the country.

According to Onyemaechi et al. (2023), Infrastructure has become an asset class for private investors, most notably through public pension funds but accessing the funds poses challenges. Conditions for accessing pension funds for investment include a guarantee for the safety of funds and equity in the distribution of investment returns by the investors. This paper is designed to test the relationships between investment in housing infrastructure and safety-equity factors in Nigeria's public pension funds management. The research design was based on an ex post facto method of analysis. from primary and secondary sources of data which were drawn from legislative Acts/gazettes, guidelines, books, journals, conferences, workshop and seminar papers, newspapers, statistical tables, and the internet. The outcomes of this study showed that public pension funds have strong relationships with the safety of funds and equity returns factor, among other key elements necessary to grow and sustain public pension contracts. These findings open a vista for future intellectual architecture-building in the field of pension funds administration.

Javier et al. (2023) examines Pension Fund Investment in Infrastructure and Global Financial Regulation. It discusses the current regulatory context and outlines the regulatory changes that may be needed to expand infrastructure investment. A panel data analysis was used to assess how important a country's financial regulatory stance is for pension fund investments in infrastructure. Although financial regulatory restrictions on infrastructure investment could be important, other influences include a country's institutional framework, as well as the depth and strength of its financial markets, along with geographical considerations. If pension funds are to invest more in infrastructure, it may be necessary to revisit conventional regulatory considerations.

Christian and Wobiaraeri (2023) studied pension fund administration and infrastructure financing in Nigeria. The study used a correlation research design with all the licensed pension fund administrators in Nigeria as a population. Findings from the study showed that there was a Relationship between Retirement Pension Accounts and Return on Economic and Social Infrastructural Financing while there is a significant relationship between Superannuation Pension Accounts and Economic and Social Infrastructure Financing in Nigeria. The study concluded that with the pool of pension funds, investment in infrastructure projects will be very meaningful and relevant to the growth of Nigeria's economy.

Tule et al. (2022) studied 'Leveraging Pension Funds for Financing Infrastructural Development in Nigeria'; they found that Pension Funds are seen as an additional source of much-needed capital to fund Nigeria's infrastructure projects. They also found that it provides a means for individuals to accumulate savings over their working life to finance their consumption needs in retirement, either through a lump sum or by the provision of an annuity, while also supplying funds to end-users such as corporations or governments for investment.

According to Arestis et al. (2022), financial development and economic growth have a high positive correlation. Such a correlation between financial development and economic growth exists in economies with high initial incomes per capita, while in countries with low initial incomes per capita, such a correlation has no statistical significance. In his study, Casey (2023) analyzes the reforms European Union governments undertook in their pension systems. These pursued reforms and policies succeeded in meeting their objectives only because the national accounts system does not recognize how most fiscal gains match future fiscal obligations.

Hu (2012) studied the impact of Asian pension funds, in particular, the key transmission mechanisms from pension reform to financial development. With the aid of the panel error correction model, a statistical relationship between pension asset growth and the development of financial and capital markets was established. This was corroborated by Catalan et al. (2000) in their investigation of the relationship between capital markets and contractual savings. The study found that contractual savings institutions, like pension funds, granger-cause capital market development. The study used data on capital market capitalization and value traded from 26 countries, six of which were developing economies.

Gunu and Tsado (2012) studied the effect of the introduction of the Contributory Pension Scheme (CPS) on savings mobilization, capital market development, and economic growth stimulation in Nigeria. Using secondary data which were analyzed using descriptive statistics, charts, and percentages, the study noted that pension funds investment as a percentage of the total market capitalization rose consistently from 2.36 percent in 2007 to 4.53 percent in 2010. The paper therefore inferred that through the capital market; the CPS had contributed to the general economic development in Nigeria.

Della-Croce et al (2011) examined the latest ideas in the world aimed at leveraging pension funds in financing green growth-related projects. The paper itemized various financing options and the role of government and pension fund regulatory and supervisory authorities in utilizing pension funds for economic growth. Major recommendations made by the authors include the need to ensure an enabling business environment, the creation of a more liquid market to support the commitment of funds

to enhancing green infrastructure, and the removal of impediments to investments. The contributions of pension funds from Nigeria's private and public sectors have increased greatly and constituted a large investment fund in the capital and money markets. This phenomenon increases liquidity in the economy, creates employment opportunities, and improves the business climate. With good portfolio risk management by financial managers of pension funds, pension contributions can positively impact gross domestic product.

So far, the evidence provided by the empirical review leads to the identification of a research gap in terms of inability to investigate conclusively the relationship between pension fund investment strategies and optimality in infrastructure financing. To fill this gap the study wishes to apply the methodology which is provided next.

2.4 Modern Portfolio Theory (MPT)

Modern Portfolio Theory (MPT), developed by Harry Markowitz in 1952, revolutionized investment management by introducing a framework for optimizing a portfolio of assets in such a way that balances risk and return. The theory of MPT emphasizes portfolio diversification and suggests that investors can optimize their portfolios by combining assets with different risk levels. Infrastructure investments are considered as part of this diversification strategy.

By leveraging the principles of Modern Portfolio Theory, pension funds can make informed investment decisions, optimize their infrastructure portfolios, and effectively manage risks in the context of infrastructure financing in Nigeria. MPT serves as a valuable tool to support the research on pension funds' investment strategies, asset allocation practices, and risk management approaches in the infrastructure sector. This justifies the anchoring of this study on the tenets of the MPT.

3. Method

The study employed an ex-post facto research design, utilizing existing data from sources such as the Pension Commission, Central Bank of Nigeria, and the Securities Exchange Commission to analyze the relationship between pension fund investment strategies and infrastructure financing. The population comprised all 25 registered pension fund administrators (PFAs) in Nigeria as of December 31, 2023, with a focus on those allocating assets to infrastructure investments. A census sampling technique was used to include all relevant PFAs with available investment data. The data were collected from secondary sources, including reports and databases from PenCom, the National Bureau of Statistics, the Debt Management Office, and other financial institutions. Statistical techniques were used to analyze the data and draw conclusions.

This study adopts a research philosophy grounded in ontological and epistemological assumptions. Ontologically, the study follows an objectivist approach, treating data as objective and real, without subjective interpretations, and relies on secondary data sources (e.g., CBN Bulletin). Epistemologically, the study treats knowledge as objective and external, with an emphasis on interpreting data as it is to understand the relationship between pension fund investment strategies and infrastructure financing. The research uses appropriate techniques to analyze the data, aiming to draw generalizable conclusions about this relationship. Data analysis is conducted through descriptive statistics and ordinary least squares regression analysis to provide meaningful insights into the study's objectives.

3.1 Study Variables and Measurement

The study consisted of two (2) types of variables; dependent and independent variable.

3.1.1 Variable Measurement

The variables used in this study are dependent, independent and control variables. This have been proxied by a number of indices some of which were used in the literature. Details of the variables and their measurement are provided in table 3.1 below.

Table 1: Definition of variables

S/ N	Variable	Measurement	Nature of Variable	Source
1	Infrastructure Financing	Total Pension Fund Investment in Infrastructure Projects: Total capital allocated by pension funds specifically toward infrastructure.	Dependent	Braknia and Abderrazek (2023)
2	PPP	Volume of Private Capital Invested in PPPs: Total amount of private sector funds contributed to PPP infrastructure projects.	Independent	Kashyap and Sharma (2024)
3	Housing Project	Number of Housing Units Delivered: Reflects the volume of housing infrastructure financed by pension fund investments.	Independent	Ebere (2021)
4	Infrastructure Bond	Total Pension Fund Investment in Infrastructure Bonds: Total amount invested by pension funds in infrastructure bonds.	Independent	Gunu and Tsado (2012)
5	Co-Investment	Equity Share in Co-Invested Projects: Proportion of pension fund ownership in co-invested infrastructure projects.	Independent	Onyemaechi et al. (2023)
6	Infrastructure Funds	Net Asset Value (NAV): Total value of assets under an infrastructure fund, indicating fund performance.	Independent	Carlo et al (2023)

3.2 Model Specification

The following are the functional models used in the study.

$$\text{Inffin} = f(\text{PPP}, \text{HPFin}, \text{InfrB}, \text{Invc}, \text{InfrFund})$$

$$\text{Inffin}_{it} = \beta_0 + \beta_1\text{PPP}_{it} + \beta_2\text{HPFin}_{it} + \beta_3\text{InfrB}_{it} + \beta_4\text{Invc}_{it} + \beta_5\text{InfrFund}_{it} + \beta_6\text{Infl} + \beta_7\text{IntR}_{it} \dots \dots \dots 3.1$$

Where:

- Inffin = Infrastructure Financing
- PPP = Public-Private Partnership
- HPFin = Housing Project Financing (Real Estates)
- InfrB = Infrastructure Bonds
- Invc = Co- investment
- InfrFund = Infrastructure Funds
- Infl = Inflation
- IntR = Interest Rates

β_0 = Constant Term

β_1, β_2 = Confident of variables

μ_{it} = Error Term in period t

Sources: Onwuka and Nwafor (2018), Catalan et al. (2000), World Bank Group. (2016), United Nations Department of Economic and Social Affairs. (2024)

4. Results and Discussion

Data analysis is conducted through descriptive statistics and ordinary least squares regression analysis to provide meaningful insights into the study's objectives.

4.1 Descriptive Statistics

This study gives the descriptive statistics, and the results of the univariate test (t-test), for the dataset that was utilised for this research. According to Tabacnick and Fidell (2007), descriptive statistics are most frequently used to give a description of samples of individuals in terms of variations or combinations of variables. In addition, Ott and Longnecker (2010) wrote that "good descriptive statistics enable us to make sense of the data by reducing a large set of measurements to a few summary measures that provide a good, rough picture of the original measurements". This is according to the statement that good descriptive statistics enable us to make sense of the data. Table 2 below presents the descriptive statistics involving the mean, minimum, maximum, and standard deviation of continuous and dichotomous variables in this study, which were computed by means of STATA 16 version.

Table 2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Infrastructural financing	17	13.958	5.551	6.703	19.117
Infrastructural Bond	17	6.996	6.129	-4.605	12.632
Infrastructural Fund	9	12.201	1.873	9.047	14.247
Housing Project financing	17	10.753	4.938	4.37	14.858
Private-Public Partnership	12	10.882	4.189	1.872	13.44
Co-Investment	17	8.365	5.299	1.495	13.845
Inflation Rate	17	2.518	1.9	-.4	7
Interest Rate	17	1.413	1.785	.09	5.08

The Table 2 above presents a discussion of the descriptive statistics for variables which comprise of infrastructural financing, infrastructural bond, infrastructural fund, housing project financing, private-public partnership and Co-investment strategy which presented the result of the average mean value, minimum, maximum and standard deviation. The result from Table 2 above indicates that the average mean value of infrastructural financing (INFFIN) is 13.59; standard deviation of 5.55; minimum of 6.7; and maximum of 19.12. This implied that Nigerian pension funds have on average 14% of infrastructure financing in the system. Based on the infrastructural bond (infrB), the result shows that the average mean value of infrastructural bond is 7.00; standard deviation of 6.13; minimum of -4.61; and maximum of 12.63. Considering the infrastructural fund (infrF) in this study, the average mean value is 12.20; minimum of 9.05 and maximum of 14.25 and standard deviation of 1.87. This indicates that on the average held approximately 12.2% of total infrastructure fund in Nigeria. With regards to housing project financing (real estate), the result revealed the mean average of 10.75, minimum of 4.37, maximum of 14.86, and standard deviation of 4.94. This shows that Nigerian pension funds have on average 10.8% of housing project financing in the system.

Regarding the PPP, public-private partnership, the average mean value is 10.88; minimum value of 1.87, maximum of 13.44 and standard deviation of 4.19. Furthermore, the mean value of investment strategy is 8.36; minimum value of 1.50; maximum of 13.85 and the standard deviation of 5.30. Finally, the result of the control variable indicates that the average mean value for the inflation rate is 2.52% with the standard deviation of 1.90%; minimum value of -0.04, maximum of 7. The result of interest rate also shows the average mean size score of 1.41%; minimum value of -0.09, Maximum value of 5.08 and standard deviation of 1.78.

4.2 Correlation Analysis

Pallant (2013) noted that correlation analysis is crucial for showing the direction and intensity of undeviating associations between variables. According to Joseph (2010), a correlation value of 0 indicates no link, whereas ± 1.0 suggests a strong relationship. In accordance with Hair et al. (2019), the correlation matrix should not exceed 0.70 to prevent multicollinearity in this investigation. Table 4 shows that the Inffin and InfrB are positively and statistically correlated with the Infrf at 48.5%. This provides a signal on the regression model's PPP-InvS relationship and Infrf. At 30% significance, PPP were positively and statistically substantially linked with Inffraf. Table 4 indicates that IntrR and Inffrf positively and significantly affect Infrf at 15.6%. Also, InflR was favourably and significantly linked with Infrf at 22.8%. The overall results of the correlation analysis indicated that there is no indication of multicollinearity based on the results of the Pearson correlation analysis between the explanatory variables, which are given in Table 4. This is due to the fact that the correlation among the set of explanatory variables is, for the most part, quite low (≤ 0.7). When the correlation coefficient is between 0.80 and 0.90 or higher, a multicollinearity problem develops.

Table 3: Correlation Analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) loginffin	1.000							
(2) loginfrb	0.485*	1.000						
(3) loginfrf	0.580*	0.675*	1.000					
(4) loghpf	0.697*	0.382*	-0.223	1.000				
(5) logppp	0.299*	0.596*	0.545*	0.192*	1.000			
(6) loginvc	0.396*	0.480*	0.610	0.494*	0.984*	1.000		
(7) inflr	0.228	0.201	0.628	0.184	0.259	0.242	1.000	
(8) intrr	0.156	0.039	0.559	0.136	0.416	0.162	0.409	1.000

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Inffin – Infrastructure Financing; InfrB – Infrastructure Bond; InfraF – Infrastructure Fund; HPF – Housing Project Financing; PPP – Public-Private Partnership; InvC – Co-Investment; InflR – Inflation Rate; and IntrR – Interest Rate

4.3 Multivariate Analysis (Regression Analysis)

The present study interprets the results of the regression on the relationship between PFA investment strategy (infrastructural bond, infrastructural fund, housing project financing, co-investment and public-private partnership), control variables (inflation rate and interest rate), and infrastructural financing. Thus, the model is considered infrastructure financing as an endogenous construct and regresses the model with the

exogenous constructs. As presented in Table 4.4, the results of the relationship between PFA investment strategy, control variable and infrastructural financing show a cumulative R² of 0.198 and F- statistics is significant at 1% (p<0.01), showing that overall model is fit in explaining the level of variability between endogenous construct and exogenous constructs. Thus, the regression model 28% of the total variance in infrastructure financing is influenced by collective impact of exogenous constructs PFA investment strategy (infrastructural bond, infrastructural fund, housing project financing, co-investment and public-private partnership), control variables (inflation rate and interest rate). For the purpose of the interpretations, the indicators, such as the coefficient (β), robust standard error, t-values, and p-values were generated and presented. Thus, this study was analysed and interpreted according to the objectives. Thus, Table 5 presents the regression results of model one of the relationships between the PFA investment strategy and control variables on the infrastructural financing.

Table 4: Regression Analysis and Testing of Hypotheses

Loginffin	Coef.	Std.Err.	T	P>t	[95%Conf.	Interval]	Sig.
Loginfrb	-0.006	0.035	-0.180	0.862	-0.087	0.074	
Loginfrf	0.171	0.018	9.600	0.000	0.130	0.212	***
Loghpf	-0.355	0.343	-1.030	0.331	-1.145	0.435	
Logppp	0.023	0.110	0.210	0.836	-0.230	0.276	
Loginvc	0.102	0.026	3.930	0.004	0.042	0.161	**
Inflr	-0.007	0.014	-0.490	0.640	-0.038	0.025	
Intr	0.035	0.019	1.830	0.100	-0.009	0.080	*
_cons	20.123	5.758	3.490	0.008	6.844	33.402	
Mean dependent var		18.528	SD dependent var		0.418		
R-squared		0.1982	Number of obs		17		
F-test		291.212	Prob> F		0.045		
Akaike crit. (AIC)		-43.794	Bayesian crit. (BIC)		-42.216		

*** $p < .01$, ** $p < .05$, * $p < .1$

Source: Researcher's Computation (2024)

4.3 Tests of Hypotheses

The study tests the hypotheses of the PFA investment strategy (infrastructural bond, infrastructural fund, housing project financing, co-investment and public-private partnership) and control variables (inflation rate and interest rate) on endogenous constructs (infrastructural financing). The result of individual constructs testing on PFA investment strategy and control variables are as follows in the sub-section below:

Firstly, this study heavily relied on the Modern Portfolio Theory and predicts that PPP has a positive and significant relationship with infrastructure financing in Nigeria. In agreement with the research prediction, the result shown in Table 1.3 revealed that PPP have a positive significant relationship with infrastructural financing ($\beta = 0.171$; $t = 9.60$; $p = 0.000$). Hence, Hypotheses H₁ was supported. The hypothesis results are in line with the results of the previous studies (Eke et al., 2023; Vanguard, 2023; Okechukwu et al., 2023; Fapohunda, 2023), as well as the Nigerian regulations on PFA investment strategy.

Furthermore, in agreement with the research prediction, the result showed in Table 1.3 revealed that housing project financing (real estate) has a negative insignificant relationship with infrastructural financing ($\beta = -0.335$; $t = -1.030$; $p = 0.331$), hence the hypothesis H₂ is not supported. The result indicates that housing project financing is not a predictor for infrastructure financing in Nigeria. The finding is in line with study

of Oyedele (2023) However, the result shown in Table 1.3 revealed that infrastructural bonds have a negative insignificant relationship with infrastructural financing ($\beta = -0.006$; $t = -0.180$; $p = 0.862$). Hence, the hypothesis H_3 was not supported. Thus, the study contradicts the research prediction that the existence of infrastructural bonds improves the infrastructural financing due to their experience in global investment.

Finally, co-investment, the result shown in Table 1.3 revealed that co-investment has a positive significant relationship with infrastructural financing ($\beta = 0.102$; $t = 3.930$; $p = 0.004$). Hence, hypothesis H_4 was supported. Thus, the study agrees with the research prediction that the existence of co-investment improves Pencom due to their experience in global investment. The result aligns with previous studies on the relationship between co-investment and infrastructural financing. Thus, foreign investors are more willing to invest in an economy with a strong co-investment.

Table 1.3 revealed that infrastructural funding has a positive insignificant relationship with infrastructural financing ($\beta = 0.023$; $t = 0.210$; $p = 0.836$), thus the hypothesis H_5 is not supported. The result indicates that infrastructural funding is not a predictor for infrastructure financing in Nigeria.

The findings of this study contradicted the modern portfolio theory due to the fact that PFA strategies have been blamed for their role in the infrastructural decay, scandals and failure. Regarding the control variables, the study controlled for inflation rate and interest rate on infrastructure financing. Table 4.4 indicates a positive and significant relationship between interest rate and infrastructural financing ($\beta = 0.035$; $t = 1.83$; $p = 0.100$). However, inflation rate has a negative and insignificant effect on infrastructure financing ($\beta = -0.007$; $t = -0.490$; $p = 0.640$). Thus, the result of this relationship supports the research prediction that the existence of inflation rate negatively affects the infrastructural financing.

4.4 Research Findings:

- a. Public-Private Partnership (PPP) has a positive and insignificant relationship with infrastructural financing. The result indicates that PPP is not a predictor for infrastructure financing in Nigeria. This study contradicts the findings of Nieman and Aslam (2023) and support the findings of Mmadi (2023).
- b. Housing Project Financing has a negative and insignificant relationship with infrastructural financing. The result indicates that this proxy is not a predictor for infrastructure financing in Nigeria. This finding does not align with the result of Ebere (2021).
- c. Infrastructural Bond has a negative and insignificant relationship with infrastructural financing. The result indicates that infrastructural bond is not a predictor for infrastructure financing in Nigeria.
- d. Co-investment has a positive and significant relationship with infrastructural financing.
- e. Infrastructural Fund has a negative and insignificant relationship with infrastructural financing. The result indicates that infrastructural funding is not a predictor for infrastructure financing in Nigeria. This finding concurs with the study of Roseline and Ojuolape (2020).

5. Conclusion and Recommendation

5.1 Summary

This study has provided valuable insights into the relationship between pension funds' investment strategies and infrastructure financing in Nigeria. The study started with

the objective of exploring the relationship between pension funds' investment strategies and infrastructure financing in Nigeria, findings highlight the critical role that pension fund administrators can play in mobilising long-term financing for infrastructure development through their strategic investment decisions. Using quantitative data and statistical analysis, particularly Ordinary Least Square (OLS) regression, the analysis revealed that pension fund investment in infrastructure facilities and stocks has a positive and statistically significant impact on infrastructure financing in the country. This suggests that as pension funds allocate a greater proportion of their assets towards tangible infrastructure projects and equity instruments supporting infrastructure development, it leads to increased mobilisation of financing for infrastructure. This aligns with the view that pension funds can serve as crucial sources of long-term capital for infrastructure, given their ability to undertake large-scale, illiquid investments with predictable cash flows.

5.2 Conclusion

This research assessed several key factors influencing infrastructure financing in Nigeria, focusing on public-private partnerships (PPP), housing project financing, infrastructural bonds, co-investment, and infrastructural funding. The findings reveal that while some factors showed promise, they did not significantly predict infrastructure financing in the country.

- a. **Public-Private Partnership (PPP):** The relationship between PPP and infrastructure financing was found to be positive but statistically insignificant. This suggests that, despite the potential for PPP to support infrastructure development, it does not significantly drive infrastructure financing in Nigeria at present.
- b. **Housing Project Financing:** This factor exhibited a negative and insignificant relationship with infrastructure financing. It indicates that housing projects, despite their importance, do not appear to play a significant role in attracting financing for broader infrastructure projects in Nigeria.
- c. **Infrastructural Bonds:** The relationship between infrastructural bonds and financing was also negative and insignificant. This finding points to the limited impact of bond issuance as a tool for raising funds for infrastructure development in Nigeria.
- d. **Co-investment:** In contrast, co-investment showed a positive and significant relationship with infrastructure financing. This suggests that collaborative investment models—where both public and private sector actors share risks and rewards—are a more effective mechanism for mobilizing financial resources for infrastructure projects.
- e. **Infrastructural Fund:** Finally, infrastructural fund was found to have a negative and insignificant relationship with infrastructure financing, indicating that the existing funding mechanisms may not be sufficiently robust or effective in driving financing for infrastructure projects in Nigeria.

5.3 Recommendations

Based on the findings, several recommendations can be made to enhance infrastructure financing in Nigeria:

- a. **Enhance Co-investment Models:** Since co-investment has shown a significant positive impact on infrastructure financing, the government should focus on strengthening public-private collaboration. This can be achieved through policy

- reforms that encourage joint ventures, risk-sharing mechanisms, and incentive structures that attract both local and international investors.
- b. **Reevaluate the Role of PPPs:** While PPPs are a key part of infrastructure development, their limited impact in this study suggests that they may not be sufficiently utilized or structured to address the financing needs in Nigeria. It may be beneficial to revisit PPP frameworks, streamline regulatory processes, and create more attractive terms for private sector participation in infrastructure projects.
 - c. **Explore Alternative Financing Instruments:** The negative relationships found for housing project financing, infrastructural bonds, and infrastructural funding suggest that these avenues are not currently effective in mobilizing infrastructure capital. Policymakers should explore alternative financing instruments, such as green bonds, blended finance models, and international infrastructure funds, to diversify the sources of funding.
 - d. **Strengthen Infrastructural Funding Mechanisms:** Infrastructural funding sources need to be revisited to ensure they are appropriately structured and aligned with the financing needs of major infrastructure projects. This may include improving the efficiency of funding allocation, reducing bureaucratic hurdles, and ensuring adequate oversight.
 - e. **Foster a Favorable Investment Climate:** Creating a more conducive environment for infrastructure financing involves addressing issues such as political instability, regulatory unpredictability, and corruption. Strengthening governance structures and ensuring transparency will likely enhance investor confidence and attract more capital to the infrastructure sector.

By focusing on co-investment, improving the PPP framework, and diversifying financing mechanisms, Nigeria can improve its infrastructure financing and accelerate development in critical sectors such as transportation, energy, and housing. The study's findings underline the important role that pension funds can play in mobilising long-term capital for infrastructure development in Nigeria. By diversifying their investment portfolios to include a larger allocation towards infrastructure and equity instruments, pension funds can contribute significantly to bridging the country's infrastructure financing gap and supporting sustainable economic growth (Oyedele, 2023).

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