Article

Dynamics of the Inflation-Hedging Capabilities of Real Estate Investment Portfolios in the Nigerian Property Market

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Abstract: There has been a wide belief that real estate is a source of good investment portfolios because it has a hedge against inflation. Considering this notion, the present research examined the dynamics of the inflation-hedging capabilities of real estate investment in Nigeria's three foremost property markets, Abuja (Maitama and Central Business District), Lagos (Lekki and Victoria Island), and Port Harcourt (Rumu Ibekwe and Aba Road). To achieve this aim, this study was carried out by exploring the returns on different types of commercial properties in the chosen location and investigating the effect of inflation on such returns in order to come up with the hedging capabilities of the assets. Out of the four property prime locations in Nigeria's market, these selected study sites were purposely selected for investigation because they comprise the most desirable and preferred properties regarding location, standards, aesthetics, and value. From the data collected, a mean return, coefficient of variation, and ordinary least square regression analysis were completed. In terms of the coefficient of variation (CV), the findings reveal that the duplex in Port Harcourt exhibits the most performed investment, with a value of 0.33, compared to other locations. However, in terms of the expected return (ER), the duplex outperformed other property types in the different locations, with a return of 39.56%. Results also show that inflation has an adverse effect on the returns of the office space for the three locations considered, with the expected returns below 1%. The block of flats in Abuja has a complete defence against the three components of inflation, with a coefficient beta of 0.5633, 0.6586, and 0.8440, respectively. Thus, investors should consider inflation and other investment attributes when making decisions among arrays of investments. This will help guard against the widespread perception that real estate has a hedge against inflation. This paper adds to the existing literature on inflation hedging by investigating the effect of inflation on the real estate investment returns of commercial properties.

Keywords: expected return (ER); inflation dynamics; inflation hedge; investment; property market portfolio; property price; real estate; return on investment (ROI)

1. Introduction

Inflation is a term used to describe a purely monetary rate of upward movement in the prices of goods during a specific time frame [1–3]. In a layman's view, inflation is defined as a large amount of money chasing fewer goods, resulting in an increase in product prices [4,5]. Inflation is commonly misinterpreted as a gain in real value; however, it is a growth in the amount of credit and money that leads to a rise in the

general level of prices, resulting in a loss of purchasing power, according to the Appraisal Institute [6]. In real estate, the inflation-hedging capability can first be assessed against actual inflation while, in a more detailed analysis, actual inflation can be decomposed into two components (expected and unexpected inflation). Expected inflation describes the level of inflation investors anticipate will occur in future time periods while unexpected inflation results from a reaction caused by new market information not initially considered [7]. Although, different studies have investigated inflation based on the hedging factors of various resources in diverse economies [8–13]. In most developed countries, the rate of inflation is managed to a one-digit rate; however, in developing countries like Nigeria, it is mostly in two digits. Some recent studies have confirmed that Nigeria has a high rate of inflation and found different impacts of inflation; although, they have not considered inflation hedging capabilities [14–17]. During periods of inflation, the prices of goods and services increase as it also erodes people's purchasing power.

The pressure of inflation in Nigeria is worrisome and the nation is yet to proffer a solution to break out from the problem [17,18]. Following the data from CBN Bulletin [19], the rate of inflation in Nigeria rises on a year-on-year basis, as it was at 13%, as of December 1991. This rose to 46% by December 1992, was at 72.8% as of December 1995, and progressively declined to 6.9% in 2000 but rose to 10.8% as of December 2011 [19]. As of July 2016, the rate of inflation rose to 16.5% and was at 18.5% in October 2016 [20]. In 2017, the inflation rate dropped to 16.5% and further dropped to 12.4% in 2018. Later, in 2018, it fell slightly to 12.09% and, in 2019, it fell further to 11.701% and later increased to 15.7% in February 2022 [17,21]; however, the increase in inflation is a global phenomenon. It is noteworthy to add that the month of data projection is important. For instance, Statista presented two projection reports for Sub-Saharan Africa, including Nigeria, which covered this same issue on inflation by considering perceived inflation to have upward trends that are relatively close figures though differently reported for the same year in 2022 at 12.2% and 14.47%, respectively [22,23]. The low output, quick growth of liquidity, growing cost of funds, ongoing depreciation of local currency (Naira), and rising cost of transportation brought about by higher adjustments to fuel pump prices and related tariffs were identified as the drivers of inflation [24]. The scenario has been exerting a negative effect on the quantity and quality of real returns on most investment assets, including real estate in most of Sub-Saharan Africa.

Even though Africa only provides for 2% of the world's total manufacturing output, the urbanisation rate in Sub-Saharan Africa was roughly 41.83% in 2021 [25,26]. It holds true, despite the fact that there is a gap in Africa's industrial output globally, that there is a need to have an interest in digitalization and manufacturing as these elements could help in reducing the inflation rate in Sub-Saharan Africa in the long run. There is an inference here that migration and urban surge, in the quest for economic opportunity, have resulted in issues, such as high inflation rates, high demand for property, high waste generation, pollution, and high unemployment rates. According to the World Economic Forum [27], more than half the world's population resides in urban areas and cities continue to attract people in search of a better life and greater job prospects and services, as of 2017. Cities address the immediate needs of migrants and respond to a number of challenges brought on by integration. In that light, particularly in Nigeria, globalization, innovation, and urbanisation have led to the need for more houses. There is also an increasing demand for smart buildings in developing nations, as well as an increase in the Nigerian real estate sector. Various data have shown that, while inflation is unstable in Nigeria, CBN is struggling with ways to hedge it [28–30]. However, the crux of the analysis is that the current increase in the inflation rate in Nigeria has also affected the price index of housing properties.

Real estate investment is gaining popularity among investors worldwide as an investment option whose real terms profits increase, even in difficult economic times [31–33]. Real estate's return characteristic gives a buffer through annual cash flow and knowledgeable

investors can generate a return from real estate investment by implementing an efficient plan for a certain portfolio at a specific moment [34–36].

In Nigeria, real estate investment has been deemed to provide some hedging against various inflation components [7,37–43]. This is also evidenced in Ekemode's [44] work on the inflation-hedging attributes of residential property investments in emerging markets, using Lagos, Abuja, and Port Harcourt as case studies. Also, in Lagos State, investors have been urged to invest in real estate to help hedge funds against inflation as the property market is fast growing by attracting great investors [45]. However, a broad consensus exists that real estate acts as a deflationary hedge both in developed and developing countries; there are some occasions where it provides a paradoxical inflation hedge. Before investing in any sort of real estate property, investors must understand the inflation-hedging attribute of the property. All previous works on real estate inflation hedging in Nigeria were focused on residential properties. Although Ekemode's [44] study did focus on the three most preferred locations in Nigeria, it is worth mentioning that the study only concentrated on residential attributes; however, this present study goes further to consider commercial property investments because they serve as an income-generating portfolio for prospective investors and are rated as the next class of investment after residential properties. Also, Ekemode's [44] study did not assess how inflation could impact the returns on property types. In contrast, this current study focuses on three of Nigeria's foremost real estate markets (Maitaima and Central Business District in Abuja, Lekki and Victoria Island in Lagos, and Rumu Ibekwe and Aba Road in Port Harcourt).

This present study is location-specific because the factors that could influence property values, particularly in the Nigerian market, are not the same. They could differ in terms of location and other attributes. Thus, there is a need to investigate commercial property investments to ascertain those that can withstand the economic downturn of the nation to rightly guide investors and, at the same time, ensure they maximize their investment return. Although previous study by Lee [46] had investigated the inflation-hedging ability of commercial property investment in the Asian property market, this study seeks to examine the effect of inflation on the returns of selected commercial property types in the African property market, using Nigeria as a representative case. It will also ascertain the hedging dynamics of their investment returns. This is helpful for providing prompt advice to prospective investors to understand their investment return and, at the same time, enhancing economic growth. Real estate in Sub-Sahara Africa, especially in Nigeria, is rapidly increasing and investors tend to compete for property acquisition in various prime locations in each state without paying due cognizance to the inflation-hedging capability of their intended property investment within such locations. Against this backdrop, both local and international investors are often encumbered with a whole lot of risk. This study, therefore, considered the Nigerian property market as a replica of what is obtainable in other Sub-Saharan African countries.

This study will provide insights for prospective investors, particularly the need to take into consideration the different locational advantages that an area possesses within a given area. This study will also provide information on the real returns of property investment and, in turn, assist investors in knowing the overall performance of the investment. This means that an investor will understand how each of their property portfolios performed and what factors may have contributed to that success. Therefore, the goal of this research is to find out the dynamics of inflation hedging and its effect on real estate investment annual returns in Nigeria's three foremost real estate markets as a lesson for other similar countries. Thus, this paper is structured to include an introduction, a review of related studies, the research methodology, the results and discussions section, and, lastly, the concluding section.

2. Literature Review

This section presents the review of the extant literature and the concept adopted for the research.

2.1. Research Questions

This paper seeks to find answers to some research questions given herein. What is the return profile of the selected commercial properties within the timeframe of 2001 to 2017? What is the trend of inflation components in Nigeria? What is the effect of inflation on real estate investment returns? What are the inflation-hedging dynamics of real estate investment annual returns in the study area?

2.2. Review of Extant Literature

It is pertinent to present a literature review on the concept of inflation hedging in real estate investments. In monetary terms, hedging is a technique for reducing exposure to danger in a specific market circumstance [47–49]. For real estate investors who typically invest for the long term, inflation hedging is a big concern [50–52]. It is the ability to protect an asset against the erosion of an increase in prices. An asset with nominal returns is said to have a positive relationship with inflation [7]. During instances of excessive inflation, it has been seen that some financial instruments not only shield the investor from price increases but also provide perfect and perverse hedges in some cases [53].

In developed economies, several authors have carried out investigations on inflation and property returns. For instance, Brueggeman and Fisher [54] provide a comprehensive overview of real estate investments, highlighting the inflation hedging and role of real estate in value preservation during inflationary periods. Bodie, et al. [55] offer insights into various investment strategies, including those related to hedging against inflation. The study notes that it can provide a broader understanding of how different assets, including real estate, can play a role in managing inflation risk. Baum [56] offers insights into the strategies and implications of real estate investment, including the role of real estate as an inflation hedge. DiPasquale and Wheaton [57] also provide a deeper understanding of the economic principles underlying real estate markets, which can help contextualize the findings of the reviewed studies. Ball et al. [58] offer insights into commercial real estate markets, helping to understand the intricacies of property types' inflation-hedging potentials. Another scholarly contribution on inflation and real estate investment returns by Ibbotson and Siegel [59], the paper delves into the historical relationship between inflation and various asset classes, shedding light on the performance of real assets.

There are three main inflation components: actual, expected, and unexpected inflation. Actual inflation can be broken down into categories: expected and unexpected inflation. Expected inflation refers to the level of inflation that investors expect to occur in the future; whereas, unexpected inflation occurs as a result of the reaction to new market information that was not previously considered [7]. The Consumer Price Index (CPI), which is an official measure of inflation around the world, is frequently used as a proxy or benchmark for determining actual inflation [49,60]. The 90-day treasury note rate is frequently used as a proxy for inflation expectation [61]. Actual inflation is frequently subtracted from expected inflation to obtain unexpected inflation [43,49].

It is noteworthy to state that Fama and Schwert [60] were among the earliest researchers on inflation and real estate returns. Although Fisher's [62] hypothesis in 1930 was used to assess the ability of investment assets to hedge against inflation in the United States. The ordinary least square method was employed for the data analysis and it was found to hedge against the expected and unexpected components of the inflation rates. Rubens et al. [63] investigated the efficiency of residential, rural, and commercial real estate inflation hedging in the United States from 1960 to 1986. As a proxy for expected inflation, the Livingston price expectation was used. The hedging qualities of actual, expected and unexpected inflation on asset returns were investigated using Cochran–Orcutt regression analysis. For both individual assets and portfolios, the study found that the hedging effectiveness of various asset classes differed by varying asset and inflation types. Farmland and residential estates were perfect hedges against unexpected inflation. The findings are consistent with Fama and Schwert's [60] findings that residential properties provided a complete positive hedge. The study also found that commercial real estate provides a

partial positive inflation hedge, as well as a complete inflation hedge when compared to expected inflation.

Sing and Low [64] investigated the inflation-hedging properties of Singapore assets using Pearson correlation coefficients to determine property returns and inflation rates. The property provides a more complete inflation hedge than non-property investments, according to the study's findings. When the tests were expanded to look at the inflation-hedging characteristics of assets in both high-inflation and low-inflation environments, it was discovered that residential property offered a partial hedge against unexpected inflation in low inflation circumstances, but industrial property was a complete hedge against inflation in high-inflation circumstances. This finding is in line with Li [65], who discovered that the ability of real estate to hedge against inflation is generally greater when there is high inflation but reduces relevance during periods of low inflation. Stevenson [66] re-examined the existing relationship between the British residential property market and inflation. The study reveals that residential property type and inflation display similar long-period trend relationships and no strong existing relationship during the long term.

Chu and Sing [67] looked into the inflation-hedging attributes of real estate in the Chinese market. The authors investigated how four major Chinese cities (Beijing, Chengdu, Shanghai, and Shenzhen) dealt with short-term inflation hedging in real estate markets. The residential, commercial, and office buildings in each city were evaluated. The ordinary least square and co-integration models were used to examine the data. The results of the conventional least square model show that real estate, in any form, is a poor hedge against both predicted and unexpected inflation in all four locations. According to Wurtzebach et al. [61], office and industrial property returns do not provide a significant buffer against unexpected inflation. However, Chu and Sing's [67] findings contradict the findings of other authors [60,63,68] who claimed that real estate is a solid hedge against predicted and unforeseen inflation. More crucially, their study found that the Chengdu real estate provides a significant, although negative, inflation hedge. Chen and Sing [69] studied the inflation-hedging ability of the Hong Kong, Tokyo, Singapore, Taipei, and London housing markets. The study found that there is the existence of variations in the results of inflation hedging across the five housing markets.

Zhe [49] re-examined the efficacy of real estate and inflation hedging in Hong Kong. The rate of return on real estate was regressed against actual, expected and unexpected inflation rates in the research area using Fama and Schwert's [60] proposed ordinary least square regression model. According to the study, private domestic property and office property in Hong Kong were hedged against predicted and unexpected inflation, rather than retail and industrial property, between 1993 and 2000. Residential and commercial income returns were fully hedged against inflation every quarter; whereas, retail and industrial assets were nearly fully hedged on an annual basis. The result differs from that of Sing and Low [64], who concluded that industrial property is a good hedge. The findings possibly differed because the procedures used were different. In addition, Zhou and Clements [70] looked into real estate's potential to hedge inflation between 2000 and 2008. The Chinese Consumer Price Index was used as a proxy for inflation rates, Auto Regressive Integrated Moving Average as a proxy for expected inflation, and unexpected inflation as the difference between actual and predicted inflation.

Park and Bang [71], in Korea, studied the inflation hedging of commercial real estate investment using the autoregressive integrated moving average and co-integration model. The research paper revealed that Korean commercial real estate shows a positive short-run co-movement for expected and unexpected inflation, respectively. Lee [46] looked into Malaysia's inflation hedging of the residential property market. Fama and Schwert's [60] 1977 model was employed to analyze the inflation hedging in a short-run period and the dynamic ordinary least square method was used to analyze the data in the long-run term. The Fama and Schwert's [60] analysis shows that the residential property in the short run provides reasonable evidence against expected inflation in the Malaysian market while the DOLS model result shows strong proof that residential property is a perfect hedge in

the long run. Kuang and Liu [72] employed panel data between 1996 and 2010 among 35 Chinese major cities to examine the inflation-hedging strength of housing prices. The study found that housing prices performed well across the 35 Chinese major cities that were considered. Terahni, et al. [73] examined the short- and long-term inflation-hedging capability of residential real property investment returns in selected countries. The data were analyzed using the co-integration test. The research paper found out that in the third world populace, small- and medium-size residential real property is a good hedge against inflation. Aqsha and Masih [74] re-examined whether residential property is a full-time hedge against inflation in Malaysia. The nonlinear autoregressive distributed lag model was utilized to analyse data from 1986 to 2018. The study concludes that the residential property type portrayed a good hedge against inflation in the Malaysian real estate market.

In contrast to the conclusion of Fama and Schwert [60], there are recent works which concluded that real estate provides good inflation hedges [49,64,70–75]. Although these studies focused on the Asian property markets, its conclusion cannot be used to draw a definite conclusion for the African property markets, hence the need for this study to fill the identified gap.

In the context of Nigeria, Bello [7] looked into the inflation-hedging characteristics of residential properties in Lagos. Fama and Schwert's [60] model was used to examine the inflation and return rates of the data for the study. Residential properties have a complete inflation hedge against projected inflation, according to the research. The findings contradict those of Fama and Schwert [60], who concluded that domestic property was not a perfect hedge against the unexpected. It does, however, support the findings of Zhou and Clement [70], that real estate is ineffective as a hedge against both predicted and unanticipated inflation.

Odu [5] examined the relative hedging capacities of key commercial properties in Lagos covering the periods of 1999 and 2010. To regress real estate returns against inflation rates, Fama and Schwert's [60] ordinary least square model was employed. According to the findings, commercial properties in prime locations, such as Victoria Island and Ikoyi, give a paradoxical hedge against actual inflation; however, commercial assets in Ikeja and its environs provide a complete hedge against actual inflation. Ogunba et al. [41] studied the hedging attributes of office and shop investments in Ibadan from 2000 to 2010. The data on the returns of offices and shops were acquired from estate surveyors and valuers' firms; then, they were decomposed into income, capital, and total return components. The ordinary least square regression model proposed by Fama and Schwert [60] was employed in the study. Office/shop properties were found to be a weak hedge against actual inflation, a moderate hedge against unexpected inflation, and a complete hedge against predicted inflation, according to the study's findings. The findings support Odu's [5] conclusions that real estate was a thorough hedge against actual inflation. It is possible that the study's methodology contributed to the result's consistency.

In the bid to know whether property could hedge against inflation, Nwosu [76,77] investigated the hedging ability of private student hostels in the Akure area. Data for both studies were analyzed using ordinary least square regression. The findings show that private student hostel investment does not always have a hedge against inflation because, depending on other factors, it does provide a perverse or partial hedge against inflation. Nwosu [77] investigated the degree of connection between returns in hostel investment and inflation rates in Akure, Nigeria. Using the Philip Perron unit root method, results show the data sets exhibit different combination orders in terms of the integrations. The autoregressive distributed lag regression method was used to examine the existing degree of the relationship. The study found that there is a varying relationship between the hostel and inflation rates. In some instances, some hostels show a positive relationship while, in others, there exists a negative relationship with the inflation component.

Boubaker and Larbi [78] looked at the interdependencies of the inflation hedging of oil minerals against the stock market of BRICS countries, which are, namely, Brazil, Russia, India, China, and South Africa; however, the study did not include the real estate

analysis. In another study, Umeh and Omisore [79] looked at the possibility of residential income to hedge inflation in Ibadan for the period of 2002 to 2014, employing ordinary least square regression. It revealed that the hedging ability of residential income varies across geo-political sub-markets; residential property return shows a perverse hedge against actual inflation while total return on residential properties provides complete inflation. The rental and total returns were discovered in the Bodija estate to give complete and partial hedging against inflation. In contrast, Bello [7] finds that income and total return of residential property are at least partially hedged against inflation. Wahab et al. [43] examine the inflation hedge potential of house price returns in Abuja. According to the fully modified OLS analysis, housing is not a good inflation hedge in the short run. However, the findings of Bello [7] are consistent with the conclusion that the housing sector does not have strong inflation across the board. Umeh and Oluwasore [79] looked at residential property returns in Ibadan; whereas, Wahab et al. [43] examined the inflation hedging of Abuja property. This current study extends the research focus to Lagos, Port Harcourt, and Abuja by investigating the returns and inflation hedging of commercial property annual returns for the three locations.

In another study, Essafi Zouari and Nasreddine [80] investigated the impact of inflation hedge on housing in Paris, France against some inconsistent components and found that, when it comes to unanticipated inflation, stocks offer a hedge in the opposite direction but they do not provide much of a hedge when it comes to expected inflation. In addition, the authors found that indirectly listed real estate has a weak link with inflation, which leads investors to discount its capacity to hedge against price increases; this is in contrast to residential real estate that is physically located [79]. Dabara et al. [81] analyzed the possibilities for real estate investment to diversify and hedge against inflation from 2005 to 2014. The data were analyzed by employing descriptive and inferential statistics. The study found that direct real estate investment was seen to have the highest return of 22.48%, with a risk of 8.7155%, during the period of study. In addition, the study discovered that direct real estate provided complete hedging attributes, with a beta of 0.082, while indirect real estate investment exhibited a perverse hedging attribute of −0.126.

2.3. Metrics of Inflation in Real Estate Investment

One of the key findings of the present study is the importance of the Central Bank in the economy of Nigeria, based on various data on inflation hedging, which reflect the inflation volatility index in Nigeria as a developing nation [80,82,83]. In the Nigerian property market, Ekemode [44] (2021) re-examined the inflation-hedging qualities of residential property assets. With an overall mean return of 18.786%, Lagos property outperformed the Abuja and Port Harcourt residential properties. The results of Fama and Schwert's [60] regression show that blocks of flats in Abuja, Lagos, and Port Harcourt have a complete hedge against actual and expected inflation, a partial hedge for the three components of inflation on a detached property in Abuja, but a perverse hedge against real inflation on a detached property in Port Harcourt. A long-term link between residential property assets and actual inflation was also discovered using the Johansen and Juselius co-integration test. In contrast, this current study mentioned the location where the research was carried out and the expected return and the coefficient of variation was calculated; it is necessary to do so because property values in the Nigerian market vary depending on location. There is a need to ascertain the effect of inflation on the return of the property types; hence, this study will examine the effect of inflation on real estate property types' returns.

In economic theory, the foundations of inflation are grounded in diverse concepts, each offering unique perspectives on the causes and consequences of rising prices. One such theoretical framework is the quantity theory of money, which posits that changes in the money supply significantly impact the price level within an economy. Demand-pull inflation, another prominent theory, highlights the role of aggregate demand surpassing aggregate supply, causing upward pressure on prices. In contrast, cost-push inflation underscores the influence of rising production costs, often driven by factors such as increasing wages

or volatile commodity prices. Additionally, built-in inflation emphasises the self-fulfilling nature of inflationary expectations, where anticipated future inflation prompts actions that perpetuate rising prices.

Central to understanding inflation is the measurement of its magnitude and impact on everyday life. Among the widely recognized metrics, the Consumer Price Index (CPI) stands as a key instrument for gauging the average change in the prices of goods and services purchased by urban consumers. Alongside the CPI, the Producer Price Index (PPI) offers insights into price shifts at the wholesale level, an early indicator of potential downstream price adjustments. The Gross Domestic Product (GDP) deflator provides a broader perspective, assessing inflationary pressures across an entire economy, while the Personal Consumption Expenditures Price Index (PCEPI) offers a more comprehensive view of consumer inflation trends. Core inflation, an index excluding volatile food and energy prices, helps policymakers isolate underlying inflationary forces.

2.4. The Research Concept

The theoretical basis of this investigation was used to develop this research concept as this research bears upon the multifarious discussions in the literature earlier presented. The theoretical foundations of inflation are necessary for an in-depth exploration of the theoretical underpinnings of inflation. Some references to prominent economic theories, such as the "quantity theory of money", "the Phillips curve", and "the expectations-augmented Phillips curve", have been earlier stated to provide a more comprehensive understanding of the various factors driving inflation. Also, the types of inflation are an important aspect of this study. This study simplifies inflation to a "monetary rate of upward movement in prices," but it does not delve into distinguishing between different types of inflation, such as demand-pull inflation, cost-push inflation, and built-in inflation. However, this distinction is recommended for further study, and it is essential for a comprehensive understanding of inflation's drivers. Also, future work should include an explicit explanation of the theoretical framework underlying inflation hedging. It is important to explore the theoretical basis for why certain assets, like real estate, are considered potential hedges against inflation and how these assets interact with inflationary trends.

Based on hedging and expected inflation, it has been seen that, while the review seems to imply that "hedging against inflation" refers only to the positive relationship between an asset's nominal returns and inflation, more work is expected in future studies as hedging against inflation involves strategies that aim to preserve real purchasing power, which might not always align with expected inflation levels.

In light of this, this current research tends to fill the existing gap by taking into account a variety of types of commercial property and prime locations in Nigeria's three foremost real estate markets by ascertaining their respective total returns and real returns. Also, inflation hedging within the same time frame enables investors interested in investing in commercial property to know the inflation hedging of the class of commercial properties considered in this study. Thus, the research concept considered for this study is given in Figure 1.
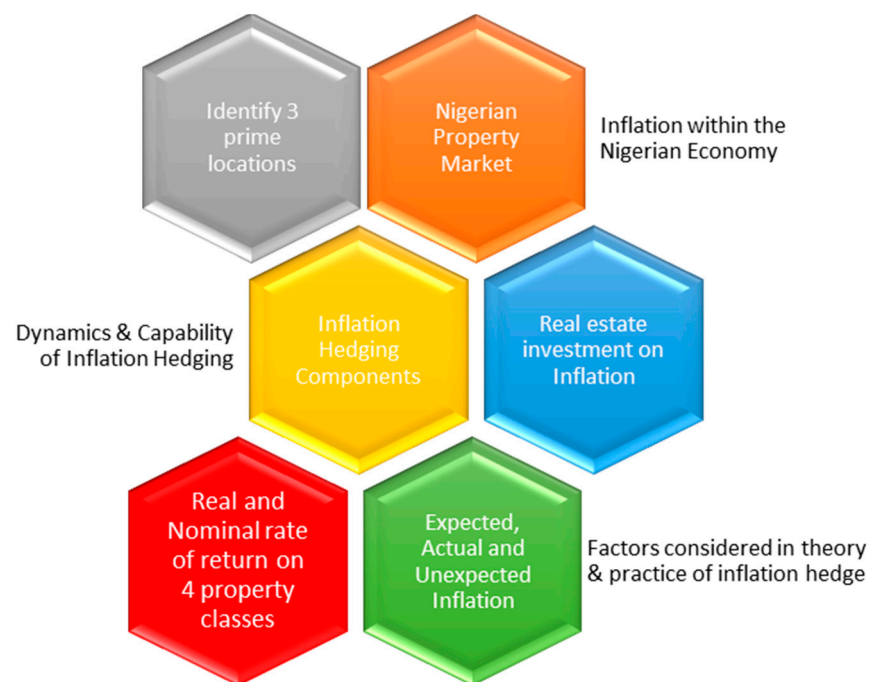
Figure 1. The research concept.

3. Materials and Methods

In this section, the materials and methods applied in this study are expressed.

3.1. The Study Areas

The purpose of this research is to analyze the inflation-hedging dynamics of real estate investment returns in some selected Nigerian cities. The research was limited to the three foremost areas of Nigeria's real estate markets, Abuja (Maitama and Central Business District), Lagos (Lekki and Victoria Island), and Port Harcourt (Rumu Ibekwe and Aba Road), in terms of commercial property markets. This was justified using findings from earlier studies that identified Lagos, Abuja, and Port Harcourt in the top hierarchy of the Nigerian property market [44,84]. The locations were selected based on the recent government investment in these sites in order to make the areas more attractive to foreign investments due to the features they offer. These locations have, over the years, yielded a high return on investment (ROI), as identified by property experts in the Nigerian built environment. The selected sites in Abuja are highly developed and are in one of the most sought-after neighbourhoods in Nigeria. This area plays host to most of the country's wealthiest individuals. Lekki, on the other hand, has grown tremendously in terms of expansion and development and is a place in Lagos that offers fantastic job opportunities; receives more government support; and has high-quality private schools, top-notch medical facilities, shopping complexes, and recreational facilities. For Port Harcourt, the site is a highly secured area with exotic architectural structures, well-paved motorable roads, and other basic social amenities for your comfort. There is a significant presence of influential politicians in the district, causing the cost of properties in the area to be quite high.

These areas were purposively selected due to their contribution to investment value, their status in the economic development of the nation, and the facelift attention they received from the government for investment and infrastructural developments, thereby opening them up for further investment opportunities. It is notable to add that Nigeria is located in the western region of the African continent. Nigeria is also a country that is known to be the most populated country in Africa, with a diverse range of buildings across the nation. Nigeria has over 200 million people living within the country. There are three major tribes and several minor tribes speaking various languages in Nigeria. Thus, while Nigeria is multi-cultural, the official language is the English language. Nigeria is

currently known to be multi-faceted, with oil as its main source of revenue; however, it also has a rising real estate sector, which contributes to the Gross Domestic Product (GDP) of the Nigerian economy. Geographically, Nigeria is bounded by land and sea and shares boundaries with three other West African nations, namely Benin Republic, Cameroon, and Niger Republic. Nigeria is made up of 36 states and a Federal Capital Territory (F.C.T.), which is currently Abuja. Figure 2 shows a map of Nigeria, showing the study areas for the three captured locations with high property markets.
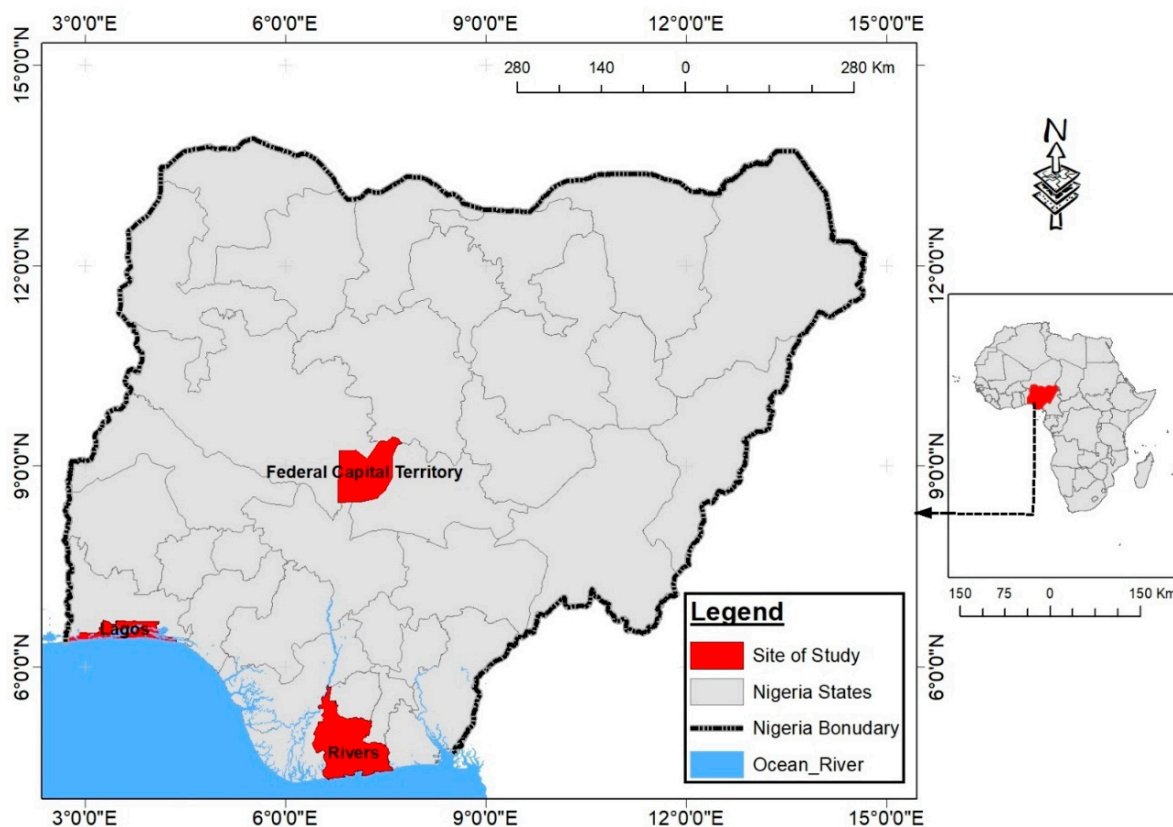

Figure 2. Map of Nigeria showing the three study locations: Lagos, Rivers and Abuja (or F.C.T).

3.2. Data Gathering

These prime locations were purposely selected for investigation because they comprise the most desirable and aspirational properties regarding location, standards of accommodation, aesthetics, and value. Purposely used commercial properties, such as duplexes, blocks of flats, and office spaces, were considered for this study. Information on the rental and capital values of properties was sourced from the practicing registered real estate firms domiciled in these selected sites. In the Nigerian property market, data on transaction indices are not readily available like they are in developed and some developing countries. Hence, to bridge the constraint, valuation-based property indices, as employed in Ekemode [44] and Nwosu [77], were adopted by collecting data on rental and capital values from the real estate firms. Data from their previous transactions over the years were obtained. The holding income return was considered because it comprises both the rental and capital return. The data on inflation required were extracted from the Nigeria Bureau of Statistics (NBS) and Central Bank of Nigeria (CBN). The inflation types considered were actual, expected, and unexpected inflation. CPI was used as a proxy for actual inflation, while the 90-day treasury bill was used as a proxy for expected inflation, and the unexpected inflation was calculated by subtracting expected inflation from actual inflation.

Furthermore, the total numbers of registered real estate firms considered in this study from Abuja, Lagos and Port Harcourt, are 119, 153, and 63, respectively. The property markets of these cities differ in terms of location and geography, economic health, popu-

lation demographics, regulations and policies, infrastructure and development, cultural and lifestyle factors, and market sentiment. As a result of the differences that exist in these markets and the uneven numbers of the presence of registered real estate firms, a census population was adopted for the sample selection since the population was a manageable frame. The number of questionnaires that were retrieved and valid for analysis was 345, which were from a total of 446 administered to the practicing estate firms.

3.3. Research Methodology

In this investigation, the research methodology is presented to give an overview of the processes undertaken in producing the results, analysing the results, and post-processing the data obtained. Figure 3 provides the research methodology process.

Figure 3. The research process.

3.4. Analysis Tools

Different analysis tools were used in this investigation. Mean return was used as the descriptive statistic while ordinary least square analysis was used as the inferential part. The average total values of commercial property were calculated using the mean return method.

The mean return formula was used to calculate the returns of the property. To achieve this, the total values of commercial properties were converted to rates of returns, as adopted by Bello [7,24,85]. The return on investment is calculated as follows;

The total return is expressed as:

$$TR_t = \frac{NI_t + CV_t - CV_{t-1}}{CV_{t-1}} \tag{1}$$

TR_t = Total return;
CV_{t-1} = Capital value of property types at the beginning;
CV_t = Capital value of property types at the end;
NI_t = Income of property types.

This is a relative measure of dispersion that is used to determine the extent of variation of data from the average or mean. It is defined as the ratio of the standard deviation to the mean. The coefficient of variation (CV) is the measure of the relationship between the risk and the expected return of an investment. It shows the level of variability of the investments concerning the expected returns:

$$CV = \frac{\delta}{\mu} \tag{2}$$

CV = Coefficient of variation;

δ = Standard deviation;

μ = Mean or average.

Real return is the actual return you receive after adjusting for inflation. It is the difference between the nominal return and the inflation rate. Real return is also known as an inflation-adjusted return:

$$1 + R_r = \frac{1 + R_n}{1 + h} \tag{3}$$

$$R_r = \left(\frac{1 + R_n}{1 + h} - 1 \right) \tag{4}$$

R_r = Real return;

R_n = Nominal return;

h = Actual inflation rate.

The ability of commercial property investment in the study area to hedge against inflation was examined using ordinary least square regression between 2001 and 2017. The equation for ordinary least square regression equation is given as:

$$\text{R}_{kt} = \alpha k + \beta y E(\Delta t / \Phi t - 1) + yj \left[\Delta t - E(\Delta t / \Phi t - 1 \right] + \varepsilon jt \tag{5}$$

where R_{kt} is the nominal return on commercial property investment over a given period $t - 1$ to t; α_k is the intercept term in the regression model, which represents the return on commercial property investment y over a given period $t - 1$ to t; B_y is the projected inflation slope coefficients for commercial property investment j concerning income return; $E(\Delta_t / \Phi_{t-1})$ is the best estimate of the expected inflation value in time t; θ_t is based on the data set that was available at the time $t - 1$, as denoted as $\Phi t - 1$; yj is the real value of the measured inflation rate's from the period $t - 1$ to t; it is the commercial property type's slope coefficient for unexpected inflation j concerning income return; $\Delta_t - E(\Delta_t / \Phi_{t-1})$ is used to measure shocks after inflation rates have been recognized θ_t, or rather the unexpected or unanticipated inflation rate, which is known in time t; and ε_{jt} is the error term for the typical commercial property return j from period $t - 1$ to t.

The regression equation was dismantled into actual inflation, expected inflation, and unexpected inflation components to better understand how different property types react to different inflationary occurrences. Thus, more equations are presented to portray that.

The following formula is the actual inflation regression equation:

$$\text{Rt} = \alpha + \beta \ (\text{AcIt}) \tag{6}$$

The expected regression equation is as follows:

$$\text{Rt} = \alpha + Y \ (\text{ExIt}) \tag{7}$$

The unexpected inflation regression equation is as follows:

$$\text{Rt} = \alpha + Y \ (\text{ExI}) + \delta \ (\text{AcI} - \text{ExI})t \tag{8}$$

where Rt is the mean nominal return on property type at time t;

α is the intercept term in the regression equation, which is also reflected in the real rate of return on the property type;

β is the coefficient for the actual inflation of the property asset, as regards income return;

AcIt is the actual inflation rate from period $t - 1$ to t;

Y is the coefficient for expected inflation;

ExIt is the estimate of expected inflation for period t;

δ is the coefficient of the unexpected inflation of the property type as regards income;

and (AcI − ExI) t is the estimate for unexpected inflation for period t.

In this study, the result of the commercial property as an asset is considered a complete hedge against inflation if the β value is not significantly less than 1, a partial hedge against inflation if significantly less than 1, and a perverse hedge against inflation if the value of β is negative. This approach is validated using the study of Wahab et al. [43], which applied a similar decision rule. In this present study, the p-value arrived at depicts the significance level of each of the property types under study. The goal of the test was to develop a foundation on which to establish a major difference in hedging capability. When the significance's outcome (*p*-value) of the inflation-hedging capability components, according to property type and location, is less than 0.05, we reject the null hypotheses (Ho). If the outcome of a significant *p*-value on the inflation-hedging capability, on the other hand, is greater than 0.05, we accept the null hypotheses. Thus, the decision rule in Table 1 applies.

Table 1. Decision rule for determining hedges against inflation.

S/N	Real Estate Hedges	Decision Rules
1	a perverse hedge against inflation	If β is negative
2	zero hedge against inflation	If β is not significantly different from 0 (that is, betwixt 0.001 and 0.000)
3	a partial hedge against inflation	If β is significantly < 1 (i.e., betwixt 0.4 and 0.1)
4	a complete hedge against inflation	If β is not significantly < 1 (i.e., betwixt 1 and 0.5)

4. Results and Discussion of Analysis

The results and discussion of the analysis of this study are given in this part.

4.1. Returns on Residential Investment

For investment assets to serve as good inflation hedges, it is essential that a positive correlation exists between their nominal interest rate and inflation. The yearly return is more reliable and can be relied upon due to the volatility of the property market. Although it is important to take cognizance of returns in the past years, the yearly returns provide the actual returns for the period of appraisal. Also, the yearly return is necessary for a study of this type that focuses on the investment appraisal of the property [40,41,43,79]. Table 2 displays the total returns of various forms of real estate investments in the cities chosen. The highest total return for the Abuja duplex was observed in 2006, with a return of 86.55%, and the lowest total return for the Abuja duplex was seen in 2017, with a return of 12.08%. The high return could be linked to the high demand for the duplex property type or the provision of some basic infrastructural facilities in a location that is of much value to the prospective tenant. Also, the total return for duplexes in Lagos was observed to be highest in 2006, with a return of 35.28%, and it was seen to be lowest in 2014, with a return of 4.45%; this performance could be attributed to low demand for the property type in the location. Port Harcourt's total return for duplexes was at its peak in 2011, with a return of 31.2%, and lowest in 2002, with a return of 10.85%; the low return could be attributed to the fact that the rent review may not be completed when due or the demand of this particular property type is not encouraging. The implication of the result for the three locations shows that the total return investment in duplexes is a viable one because all through the study period the returns were positive for the three locations. However, based on the average total return, the result shows that the Abuja duplexes outperformed the Lagos and Port Harcourt duplexes, with an average return of 39.56%; this may be because there is a higher demand for the duplex in Abuja than in Lagos and Port Harcourt.

Table 2. Average total returns of real estate investment types.

Property Type/Year	Duplex			Block of Flats			Detached			Office Space		
	Lagos	Abuja	PH	Lagos	Abuja	PH	Lagos	Abuja	PH	Lagos	Abuja	PH
2001												
2002	10.6	56.53	10.85	12.35	6.28	9.33	5.38	7.02	20.78	0.84	0.20	4.32
2003	6.08	40.1	21.03	5.99	11.24	24.29	5.27	1.52	23.86	25.28	2.96	9.42
2004	8.55	40.43	12.76	9.6	15.35	25.48	8.31	13.56	18.79	5.39	2.53	11.00
2005	15.74	47.68	13.24	15.86	13.73	23.17	6.51	16.95	25.94	2.40	2.21	11.06
2006	35.38	86.55	24.18	10.94	13.1	15.74	14.58	7.8	72.9	2.12	15.01	12.00
2007	14.49	38.87	20.81	5.7	9.01	16.8	22.12	14.53	25.3	6.26	10.56	17.06
2008	24.56	58.31	17.06	2.25	20.32	35.77	14.46	9.42	26.85	4.27	5.51	10.03
2009	12.55	38.14	16.72	4.02	10.12	43.79	9.2	7.32	35.8	2.06	4.00	9.00
2010	32.28	74.94	12.85	2.17	7.92	18.29	14.27	9.15	34.6	4.14	3.25	16.00
2011	10.82	29.72	31.2	7.62	8.12	15.39	12.04	8.91	31.97	5.49	2.80	6.04
2012	5.29	15.38	23.46	32.75	9.51	15.29	8.95	9.28	9.51	10.38	2.06	6.00
2013	5.23	19.99	12.07	10.08	6.75	4.54	4.95	6.06	11.02	7.68	2.24	5.01
2014	4.45	17.48	15.92	7.97	5.34	6.94	5.63	6.08	14.85	8.26	4.10	4.00
2015	16.91	42.1	17.67	28.49	10.07	6.72	12.7	9.1	8.49	2.90	1.96	3.02
2016	4.72	14.73	11.31	16.51	13.41	11.5	5.57	3.62	5.64	9.44	3.79	6.01
2017	4.62	12.08	12.95	20.44	20.54	23.94	13.17	6.85	6.94	10.11	7.83	4.03
Exp Return	13.27	39.56	17.13	12.05	11.30	18.56	10.19	8.57	23.33	6.69	4.44	8.38
Risk	9.80	21.75	5.70	8.89	4.55	10.65	4.84	3.89	16.49	5.81	3.76	4.29
Coefficient of Variation	0.74	0.55	0.33	0.74	0.40	0.57	0.47	0.45	0.71	0.87	0.85	0.51

The total returns of a block of flats for the three locations are shown in Table 2. During the research period, Abuja had the highest rental return of 20.54% in 2017 and the lowest return of 5.34% in 2014. Also, for Lagos, the return for a block of flats was observed to be highest in 2012, with a return of 32.75%, and lowest in 2010, with a return of 2.17%. However, Port Harcourt's total return experienced its peak period in 2009, with a total return of 43.79%, and the worst total return in 2013, with a return of 4.54%, for a block of flats. The high growth rate in 2009 was attributed to the increased demand for this property type and a decline in supply to fulfil that demand. Also, the low growth rate could be because some of these property types are experiencing a void period; hence, the void period naturally leads to low returns. Table 1 also shows that for Abuja, the total return for a detached house was highest in 2005, with a return of 16.95%, and lowest in 2003, with a total return of 1.52%. Lagos experienced the highest return for detached houses in 2007 (22.12%) and the lowest in 2013 (4.95%) while Port Harcourt had the best return of 72.9% in 2006 and the worst total return of 5.64% in 2016 for the same type of property. The low total return may be attributed to the low patronage of this particular property type in Abuja. The total return for office space, as shown in Table 1, shows that the three locations experienced their highest returns in Lagos with 25.28% in 2003, Abuja with 15.01% in 2006, and Port Harcourt with 17.06% in 2007; meanwhile, the lowest were seen in 2002 with 0.84%, 2002 with 0.20%, and 2015 with 3.02% for Lagos, Abuja, and Port Harcourt, respectively.

The expected return for Lagos property types shows that the duplex outperformed other property types considered with an expected return of 13.27%. This finding implies that the duplex property type in Lagos is more viable in the prime location. In this vein, Abuja's expected return was seen to be 39.56%. This result implies that it performs better than other classes of property under investigation. This scenario is quite different in Port Harcourt, where a block of flats' expected return outperformed duplexes and detached properties, with a return of 23.33%. This finding is contrary to Lagos and Abuja, where the duplex property type was seen to be the best class of property in the respective location.

However, the Abuja duplex's expected return outperformed other property types during the period of investigation; this could be traced to the fact that Abuja is the state capital of Nigeria, the class of property is highly sourced for, and a limited quantity has been provided. This contradicts the findings of Ekemode [44] that Lagos' blocks of flats outperformed the Abuja and Port Harcourt blocks of flats.

As seen in Table 2, the expected return from an Abuja duplex is the highest (39.56), with a correspondingly high risk (21.75), while that of an Abuja detached property is the lowest performing in terms of return and risk (8.57; 3.89). However, the results of the risk-return tradeoffs of the various investments are revealed by the coefficient of variation in Table 1. The coefficient of variation (CV) is the measure of the relationship between the risk and the expected return of an investment. It shows the level of variability of the investments concerning the expected returns. As seen in Table 2, a Port Harcourt duplex exhibits the best investment performance, with a CV of 0.33, while this is followed by a block of flats in Abuja, with a CV of 0.40, among other property types. The implication of this is that for a unit rise in the level of risk of commercial property investment in the study area, there is a corresponding deviation of 0.33 from the mean of a duplex property in Port Harcourt; 0.40 deviation from the expected return, while it is quite high (0.74), for a Lagos duplex and block of flats; as well as a very high (0.87) deviation for a Lagos office space. Thus, the risk-return tradeoffs are higher for the Lagos commercial property market as well as the Lagos residential property market than in the other property locations of study.

4.2. Effect of Inflation-Hedging Components

Another important finding of this study is the inflation-hedging dynamics of real estate investment returns obtained using three inflation-hedging components (actual, expected, and unexpected inflation rates), as shown in Table 3 for the selected years.

Table 3. Actual, expected, and unexpected inflation rates in Nigeria.

Year	Inflation (%)		
	Actual	**Expected**	**Unexpected**
2001	18.89	17.5	1.39
2002	13.08	19.03	−5.95
2003	13.93	14.79	0.86
2004	15.38	14.34	1.04
2005	17.85	7.63	10.22
2006	8.38	10	−1.62
2007	5.42	6.85	−1.43
2008	11.53	8.2	3.33
2009	12.59	3.79	8.8
2010	13.76	3.85	9.91
2011	10.85	9.7	1.15
2012	12.24	13.64	−1.4
2013	8.52	10.85	−2.33
2014	8.06	10.5	−2.44
2015	9.02	9.39	−0.37
2016	15.63	10.12	5.51
2017	17.07	15.92	1.15

Sources: The Nigeria Bureau of Statistics (NBS) database and the Central Bank of Nigeria (CBN).

The rate of inflation volatility in the Nigerian economy, as given in Table 3, reflects the inflation position for baselines considered from 2001 to 2017, using data accessed from the Nigeria Bureau of Statistics (NBS) and the Central Bank of Nigeria (CBN). The dynamics of real inflation rates indicate that the Nigerian economy is exceedingly unstable. From 2001 to 2005, the actual inflation rate was double-digit; then, it was single-digit from 2006 to 2007 and double-digit again from 2008 to 2012. However, it was a single-digit value from 2013 to 2015 and a double-digit value from 2016 to 2017. The ramification of the findings reveals that the Nigerian government is having major difficulties sustaining a single-digit range. Expected inflation rates were seen to be high in 2002 and continued to decrease from 2002 to 2011. The expected inflation shows that it continues to decrease at a higher rate compared to the actual inflation rates. The actual and expected inflation components decrease constantly and reliably across the research period, as seen in Table 3. In 2005, the unexpected inflation increased to 10.22 and dropped sharply in 2006 to a negative digit. Thus, it reflects that these inflation-hedging components are important in measuring the extent of investment needed and could also be used to make decisions, provide relevant directives, and support policy-making processes.

4.3. Inflation-Hedging Capability of Real Estate Investment Rental Returns

One of the findings of this study is the practical implication of inflation on the economy and how it could be hedged through investing in the real estate sector. This study shows that there are various concepts that serve as the conceptual foundation for inflation-hedging capabilities. Looking at the theoretical framework considered on the inflation-hedging dynamics of real estate investment returns, it was presented that three inflation components are important but, also, that the theory and the reality are not exactly the same values. Thus, this study looked at the investments from the nominal and real returns. The other aspect considered was how the expected inflation, actual inflation, and unexpected inflation are interconnected. This shows that the Nigerian economy reflects an inconsistent nature within the period of study, based on the inflation rate (see Figure 4).
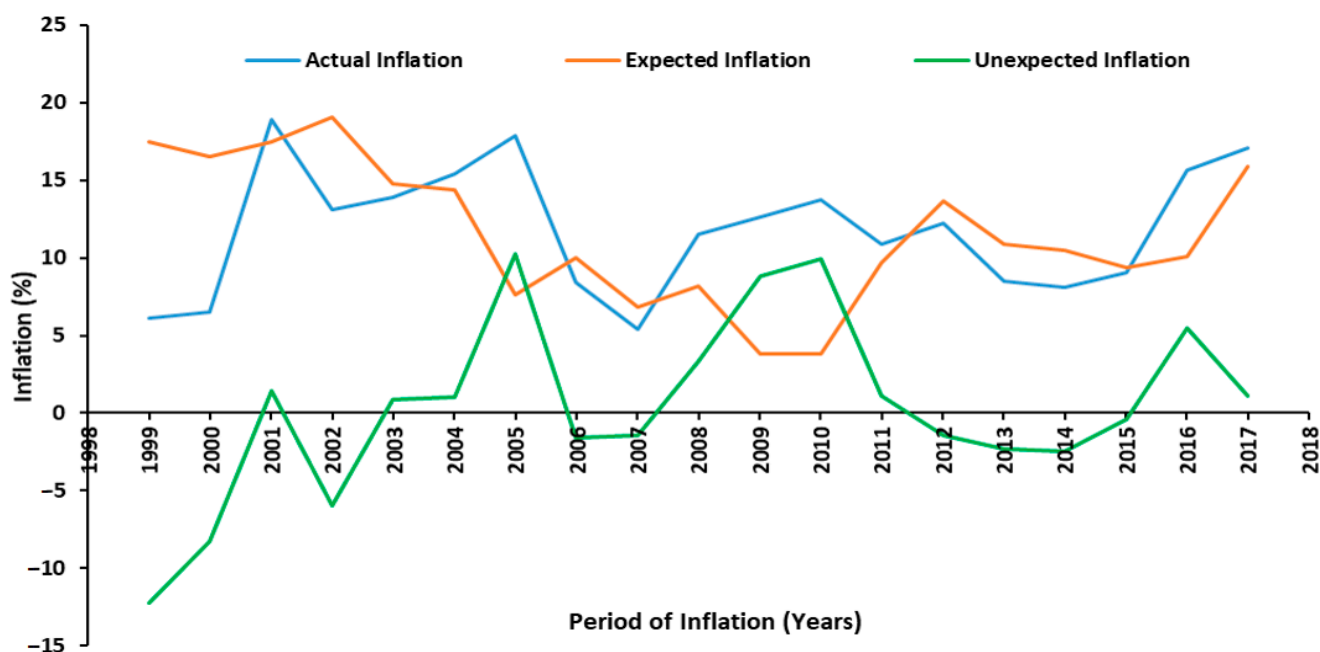

Figure 4. Trend analysis showing actual, expected, and unexpected inflation rates of the Nigerian economy in the selected years under investigation (Data Sources: CBN, NBS).

Figure 4 illustrates the temporal evolution of the actual, predicted, and unexpected inflation rates throughout the period spanning from 1999 to 2017. The data indicated a recurring pattern of annual fluctuations in inflation rates in Nigeria. Both actual and

anticipated inflation rates demonstrated annual increases and decreases throughout the observed period. Conversely, unexpected inflation rates displayed positive as well as negative fluctuations over the same timeframe, which reflect the factors that were unanticipated. The presence of a negative fluctuation in unexpected inflation suggests that the 90-day treasury bill rates on federal government bonds, commonly utilised as a substitute for anticipated inflation, exhibited a superior performance compared to other interest rates in the capital market during the specified timeframe. Conversely, a positive fluctuation in unanticipated inflation rates yielded contrasting results. The fluctuations in actual inflation have correspondingly influenced the fluctuations in interest rates in both the money and capital markets, as seen by their impact on the CPI over a specific time frame.

The availability of real estate is restricted, making it a tangible asset with limited value. Due to this, it is appealing to investors during times of inflation, which can cause the value of 'paper assets', such as stocks, treasury bills, and bonds, to deteriorate. In reality, the amount of money generated from real estate can be increased to account for rising prices. This is usually conducted through monetary policies implemented by banks and various financial institutions. Rents may be increased by landlords to compensate for the increased cost of living. This helps to keep the revenue from real estate at its previous level of purchasing power. Also, debt can be used as a leverage tool when investing in real estate. Inflation can work to the borrower's advantage when real estate is used as collateral for a loan since it causes the value of the property to rise while simultaneously causing the real value of the loan to fall, thereby decreasing the debt.

In principle, the combination of these characteristics ought to make real estate an excellent inflation hedge. However, it is essential to keep in mind that real estate does not constitute a foolproof hedge. During times of high inflation, there could be increased interest rates, thereby making it more costly to fund various investments in real estate. High inflation can also make it more difficult to obtain credit. Additionally, there is a possibility that the real estate market is cyclical and, when there is a recession, property values may decrease. There are various theoretical dynamics at play regarding the returns on real estate investments when inflation is present. First, it is anticipated that there will be a favourable correlation between real estate returns and inflation. This indicates that one might anticipate greater profits on real estate investments as a result of rising inflation. It is also reasonable to anticipate that the strength of the correlation between real estate returns and inflation will differ substantially, depending not only on the kind of real estate but also on the location of the property. Thus, in this study, we considered the prime locations in the Nigerian property market—Abuja, Lagos, and Port Harcourt. In this study, it is anticipated that investing in commercial real estate could provide a more reliable hedge against inflation. This is due to the fact that commercial leases often have longer terms and are capable of being modified more regularly to account for changes in the rate of inflation. In addition, during times of inflation, the value of real estate located in desired regions, such as large urban centres, is anticipated to increase at a faster rate than those located in less desirable areas.

During times of strong inflation, it is reasonable to anticipate greater swings in the returns obtained from real estate investments. This is due to the fact that the real estate market is vulnerable to changes in economic conditions, as well as interest rate fluctuations. When seen as a whole, the inflation-hedging dynamics of real estate investment returns theoretical idea shows that real estate can be a strong inflation hedge over the long term. However, prior to investing, it is essential to carefully analyse both the risks and the potential rewards. The authors suggest that there should be advice sought from a financial and property adviser/consultant before delving into large-scale investment in real estate, especially in economies that are unstable, non-productive, and reliant on external aid, like Nigeria.

4.4. Effect of Inflation on the Nigerian Economy

Another key result of this study is the effect of inflation on the Nigerian economy. Figure 5 shows the actual inflation against a period of inflation in Nigeria, for 2001–2023. It can be observed that there are highs and lows on the actual inflation plot, as well as the 2-period moving average for the actual inflation being obtained. The linear plot for the actual inflation shows that the inflation is increased with an R-squared value of 0.0449, with a linear equation of y = 0.1267x − 241.49. This implies that the rate of inflation is steady and can be controlled by one variable, x.
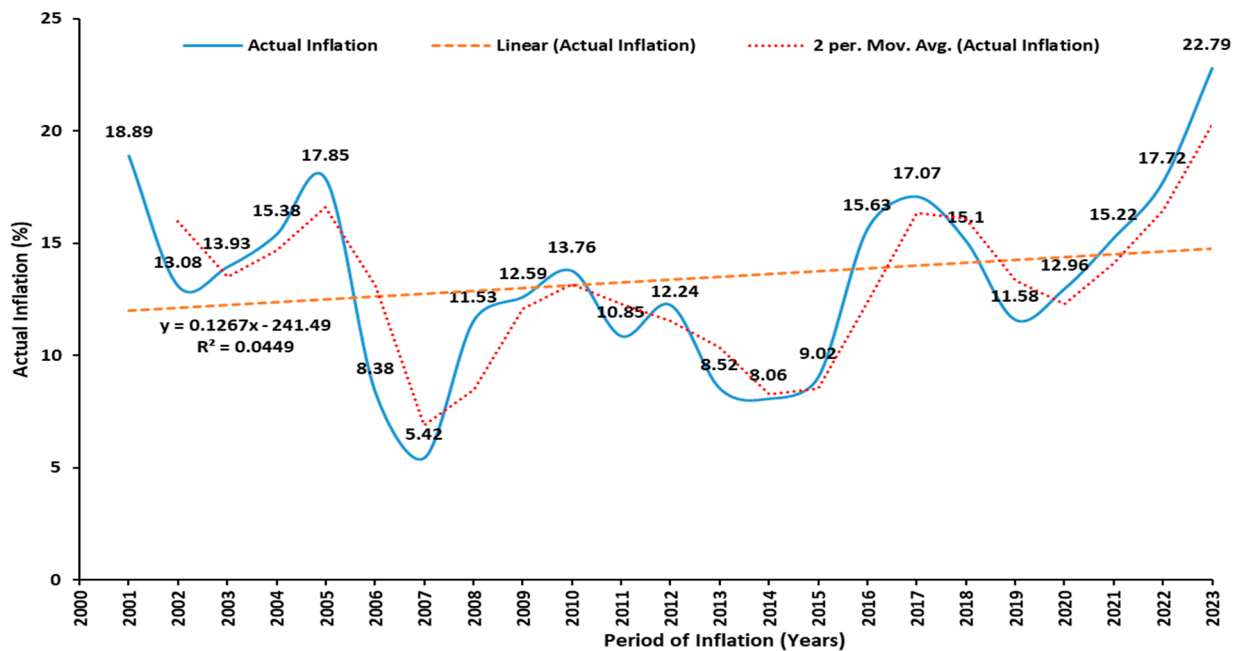

Figure 5. Actual inflation against an inflation period in Nigeria, for 2001–2023 (Data Source: CBN).

Using the multiple-digit inflation rate in Nigeria from 2001 to 2023 in Figure 5, it can be seen that Nigeria has currently hit the highest inflation rate, which is 22.79% as of 2023. However, while the Central Bank of Nigeria (CBN) is applying various approaches to control the rate of inflation in Nigeria, the prices of both commercial and residential properties are rising in Nigeria, which is also due to the restrictions on foreign exchange and the rising interest rate given to commercial banks in Nigeria from the CBN, as per the Monetary Policy Rate (MPR).

It is worthy of note that the CBN's past and present leaderships have adopted different economic policies in the pursuance of price stability. Currently, the present administration of President Bola Ahmed Tinubu has pulled together economists in the country, including those who have earlier led the CBN, to drive the economy positively. Furthermore, it is well known that there are various factors driving inflation other than the results of monetary policies. Thus, a good understanding of the inflation-hedging dynamics is important, which can be deduced from the inflation rates of the nation. The findings of Dabara [81] reflected that it is challenging for the Nigerian government to reduce the inflation rates and maintain them in the single-digit range. This is evident within the trendlines as Nigeria's inflation rates in some years during the 1980s and 1990s were higher than those of 2023. The present study has observed that Nigeria has recorded the highest inflation rate in its financial history and it has not dropped at the time of this investigation in 2023. However, while Dabara [81] had a more conservative approach to discussing inflation in developing countries, Zhou and Clement (2010) also posited that real inflation rates in developed countries were mainly in the single digits. This finding is in line with Sing and Low's [64] findings that the expected inflation is consistent in its decrease. Comparatively, it can be seen from the inflation plot in Figure 4 that in 2005, the unexpected inflation increased

to 10.22 and dropped sharply to a lower value (negative digit) in 2006. This reflects the Nigerian economy as quite inconsistent in nature within the period of study.

There are some real-world applications of the theoretical notion of the inflation-hedging dynamics of the returns on real estate investments that need to be considered. If an investor is worried about the effects of inflation, one option available to them is to invest in commercial real estate that features long-term leases. In this way, the investor would be able to reap the benefits of both increasing rents and the value appreciation of the property. Also, if an investor is looking for a more solid investment, one option they have is to put their money into residential real estate that is located in a desirable area. This would supply the investor with a consistent stream of income from rents, in addition to the possibility of capital appreciation over the course of time. During times of high inflation, an investor who is willing to assume a greater level of risk can decide to put their money into real estate. There is a possibility that this is a wonderful chance to acquire real estate at a reduced price and to profit from future increases in the value of property. It is essential to keep in mind that this is merely a conceptual framework and that the outcomes in the real world may differ. Before making any decisions about investments, investors should always discuss their options with a qualified financial professional.

4.5. Effect of Inflation on Real Estate Returns

Another important finding of this study is the effect of inflation on real estate returns. Table 4 shows the effect of inflation on the return of real estate property types in the study area. The result shows that inflation had an adverse effect on Abuja blocks of flats, Lagos and Abuja detached properties, as well as office spaces in Lagos, Abuja, and Port Harcourt office, with expected returns of -0.66, -1.54, -3.04, -4.74, -6.69, and -3.21, respectively. The effect of inflation on the Abuja duplex and Port Harcourt detached properties exhibited the highest real returns, with returns of 24.69% and 10.24%, respectively. In total, 50% of the investment return was a negative figure. Real estate can be presumed as a long-time investment that requires a huge capital injection at the beginning. The real return fluctuated throughout the period of study. This result implies that investors should always consider the effect of inflation on their returns because the issue of inflation is now a global issue; hence, every investor should not take it for granted. Table 4 shows the implication of the ever-changing inflation rates in Nigeria on the expected returns of the investments in real estate housing markets. As seen in the table, the real returns of commercial property investments during the periods considered in all the locations are mostly negative, implying that they could not cover the high inflation level of the economy. The duplexes in Abuja performed well in real terms, except for in 2016 and 2017, where they exhibited a negative real return performance; the other investments showed very little desirability in terms of real return performance. A duplex in Abuja is the only investment that has a real return higher than the risk level, which makes it more desirable as it performed better in the real term.

It is noteworthy to state that this present study only gives an exposition and insight into each individual property market investigated. This is being conducted to better understand the performance of individual property in each of the markets. Although the findings in this present study are reliant on the fact that variations do exist in property markets, particularly where the markets are dissimilar in terms of population, presence of real estate practitioners, location, and coverage, it will be worthwhile to state that future research could implement the use of an institutionalized involvement hypothesis, such as that of Lee and Lee [86]. This will help provide credence and a better perspective of an in-depth analysis to understand the comparison of hedging properties of buildings traded in markets, which are so dissimilar among them.

Table 4. Effect of inflation on real estate investment returns.

Year	LAG	ABJ	PH	LAG	ABJ	PH	LAG	ABJ	PH	LAG	ABJ	PH
		Duplex			Block of Flats			Detached			Office Space	
2001	--	--	--	--	--	--	--	--	--	--	--	--
2002	−2.19	38.42	−1.97	−0.65	−6.01	−3.32	−6.81	−5.36	6.81	−10.83	−11.39	−7.75
2003	−6.89	22.97	6.23	−6.97	−2.36	9.09	−7.60	−10.89	8.72	9.97	−9.63	−3.95
2004	−5.92	21.71	−2.27	−5.01	−0.03	8.75	−6.13	−1.58	2.96	−8.66	−11.14	−3.79
2005	−1.79	25.31	−3.91	−1.69	−3.50	4.51	−9.62	−0.76	6.86	−13.11	−13.27	−5.76
2006	24.91	72.13	14.58	2.36	4.36	6.79	5.72	−0.54	59.53	−5.77	6.11	3.34
2007	8.60	31.73	14.60	0.27	3.41	10.79	15.84	8.64	18.86	0.80	4.88	11.04
2008	11.68	41.94	4.96	−8.32	7.88	21.73	2.63	−1.89	13.74	−6.51	−5.40	−1.34
2009	−0.04	22.69	3.67	−7.61	−2.19	27.71	−3.01	−4.68	20.61	−9.36	−7.63	−3.19
2010	16.28	53.78	−0.80	−10.19	−5.13	3.98	0.45	−4.05	18.32	−8.45	−9.24	1.97
2011	−0.03	17.02	18.36	−2.91	−2.46	4.10	1.07	−1.75	19.05	−4.84	−7.26	−4.34
2012	−6.19	2.80	10.00	18.27	−2.43	2.72	−2.93	−2.64	−2.43	−1.65	−9.07	−5.56
2013	−3.03	10.57	3.27	1.44	−1.63	−3.67	−3.29	−2.27	2.30	−0.77	−5.79	−3.24
2014	−3.34	8.72	7.27	−0.08	−2.52	−1.04	−2.25	−1.83	6.28	0.19	−3.67	−3.75
2015	7.24	30.34	7.93	17.86	0.96	−2.11	3.38	0.07	−0.49	−5.61	−6.47	−5.51
2016	−9.44	−0.78	−3.74	0.76	−1.92	−3.57	−8.70	−10.39	−8.64	−5.35	−10.24	−8.32
2017	−10.63	−4.26	−3.52	2.88	2.96	5.87	−3.33	−8.73	−8.65	−5.95	−7.89	−11.13
Exp Return	1.20	24.69	4.67	0.03	−0.66	5.77	−1.54	−3.04	10.24	−4.74	−6.69	−3.21
StDev	9.92	20.26	7.16	8.11	3.70	8.82	6.43	4.63	16.15	5.54	5.36	5.20
Coefficient of Variation	8.26	0.82	1.53	318.81	−5.57	1.53	−4.18	−1.52	1.58	−1.17	−0.80	−1.62

4.6. Parametric Study on the Four Classes of Investment in the Study Area

Figures 6a, 7a and 8a show the trend in the nominal rate of returns of the different locations of study while Figures 6b, 7b and 8b show the trend in real returns of the three different locations of study. From Figures 6a and 7a, it is evident that Abuja recorded its duplex property's nominal rate of return to have peaked in the year 2006 at an average growth rate of 35.38% in Lagos and 86.55% in Abuja. In Figure 7a, the duplex value in Abuja was 2017; it had a rate of return that was higher than that from the preceding year while it reached its lowest rate of return in the year 2021. In 2017, it was at a growth rate of 12.75%. Also, from Figure 7a, it was seen that there was a slight increase in the return of duplex property in Lagos and a fall in 2008. From Figures 6a and 7a, it can also be seen that blocks of flats had better output than the detached buildings in Lagos and Abuja. However, from Figure 8a, it can also be seen that for blocks of flats and detached buildings, the housing market in Port Harcourt outperformed other locations of study. As seen in Figure 6b, the duplex in the surveyed Abuja property market showed a real rate of return that peaked in the year 2006 at an average growth rate of 72.13% from the preceding year; meanwhile, it reached its lowest rate of return in the year 2017 at a growth rate of −17.99% from 2016. Also, there was a slight increase in the return of duplex property in Lagos and a fall in 2012. This property type performed better in Abuja than other locations, though with a declining trend through the period of study. For blocks of flats and detached buildings, the housing market in Port Harcourt outperformed other locations of study. All the property types in Lagos, Abuja, and Port Harcourt experienced a sharp fall in 2009, except Port Harcourt detached buildings, which experienced an increase in 2009. The fall in return could be

attributed to the economic meltdown that hit the global economy; real estate investment in Nigeria was no exception.
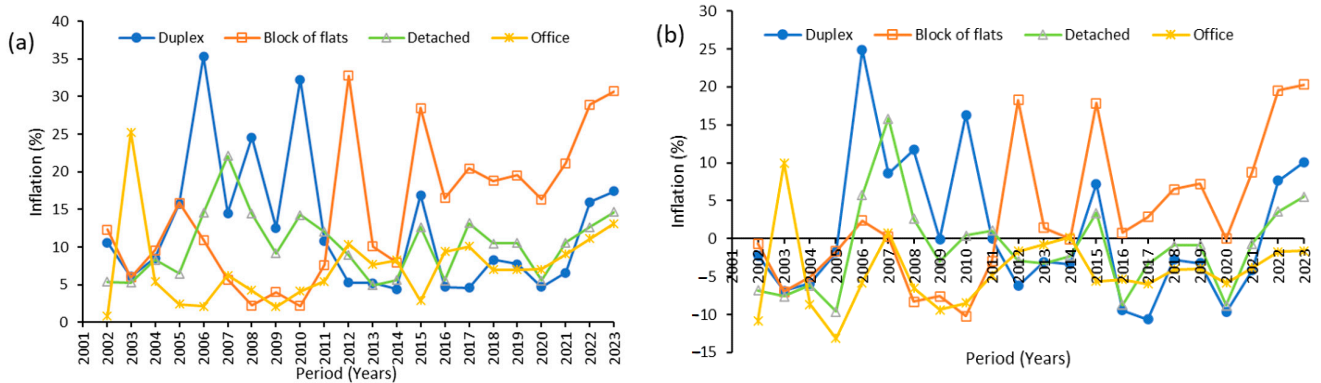

Figure 6. Comparative plots for the classes of investment portfolio investigated in Lagos showing the (**a**) nominal and (**b**) real rate of return.
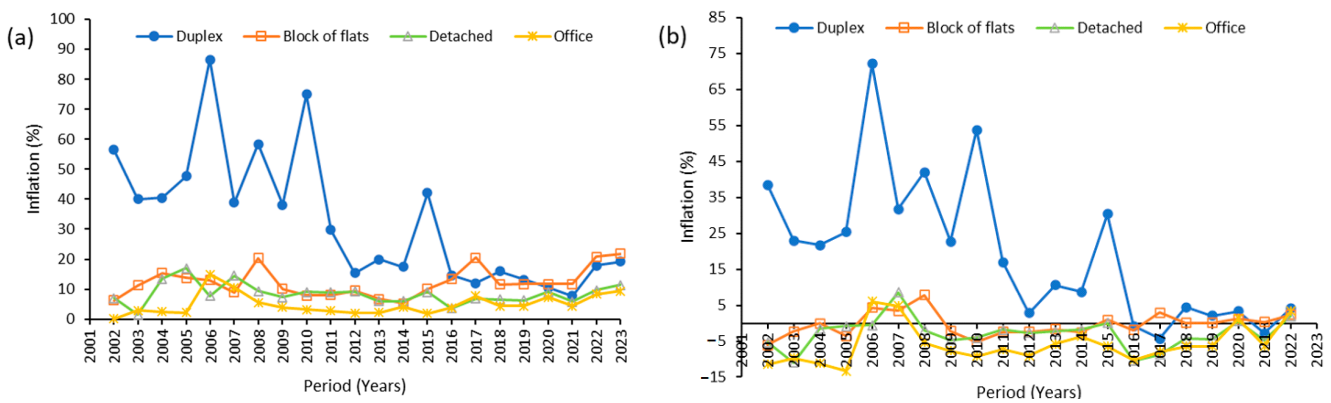

Figure 7. Comparative plots for the classes of investment portfolio investigated in Abuja showing the (**a**) nominal and (**b**) real rate of return.
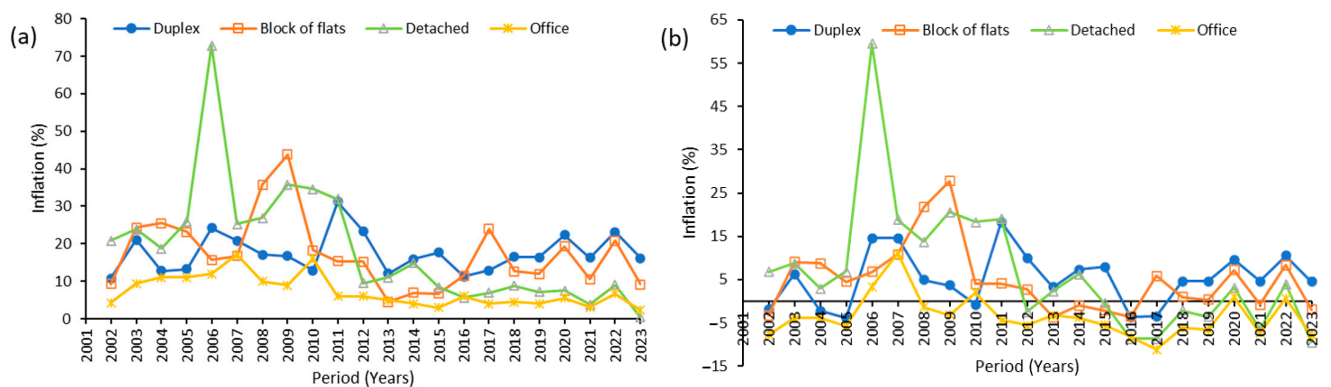

Figure 8. Comparative plots for the classes of investment portfolio investigated in Port Harcourt showing the (**a**) nominal and (**b**) real rate of return.

4.7. Nominal Rate of Return and the Real Return of the Four Classes of Investment in the Study Area

An investigation was conducted on the nominal rate of return and the real return of the four classes of investment in the study area. This is presented in Figures 9–12. Figures 9a, 10a, 11a and 12a show the trends in the nominal rate of returns of four classes of investments across the different locations of study while Figures 9b, 10b, 11b and 12b show the trends in the real rate of returns of four classes of investments across the different

locations of study. In Figure 9, the duplex in the surveyed Abuja property market showed that the nominal rate of return peaked in the year 2006, at an average growth rate of 86.55% from the preceding year, while it reached its lowest rate of return in the year 2017, at a growth rate of 12.75%. Also, there was a slight increase in the return of duplex property in Lagos and a fall in 2012. This property type can be said to have performed better in Abuja than other locations, though with a declining trend through the period of study. For the blocks of flats and detached buildings, the housing market in Port Harcourt can be said to outperform other locations of study. All the property types in Lagos, Abuja, and Port Harcourt experienced a sharp fall in 2009, except Port Harcourt detached properties, which experienced an increase in 2009. The fall in return could be attributed to the economic meltdown that hit the global economy; real estate investment in Nigeria was no exception. Abuja's duplex property's nominal rate of return peaked in the year 2006, at an average growth rate of 81.5% from the preceding year, while it reached its lowest rate of return in the year 2017, at a growth rate of −17.99% from 2016. From Figure 12, it was seen that there was a slight increase in the return of duplex property in Lagos and a fall in 2008. This property type could be deemed to have performed better in Abuja than other locations, though with a declining trend through the period of study. For blocks of flats and detached buildings, the housing market in Port Harcourt outperformed other locations of study. The returns rose from 2007, at a 113% growth rate, to 2009, where it peaked at a growth rate of 22.4%. However, the detached building rate of return became the highest in the year 2006, at an average growth rate of 181% from the year 2005.
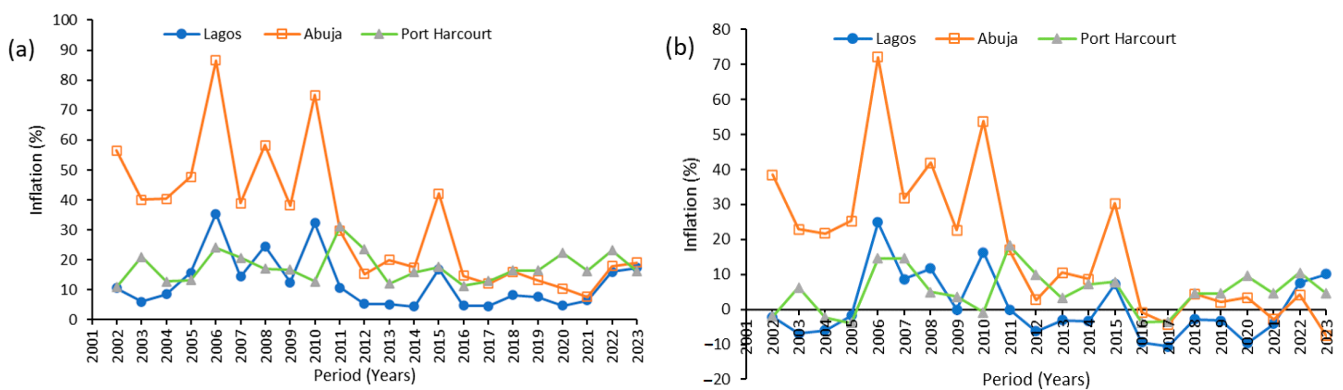

Figure 9. Comparative plots for the investigated property type (duplex) in the three study locations showing the (**a**) nominal and (**b**) real rate of return.
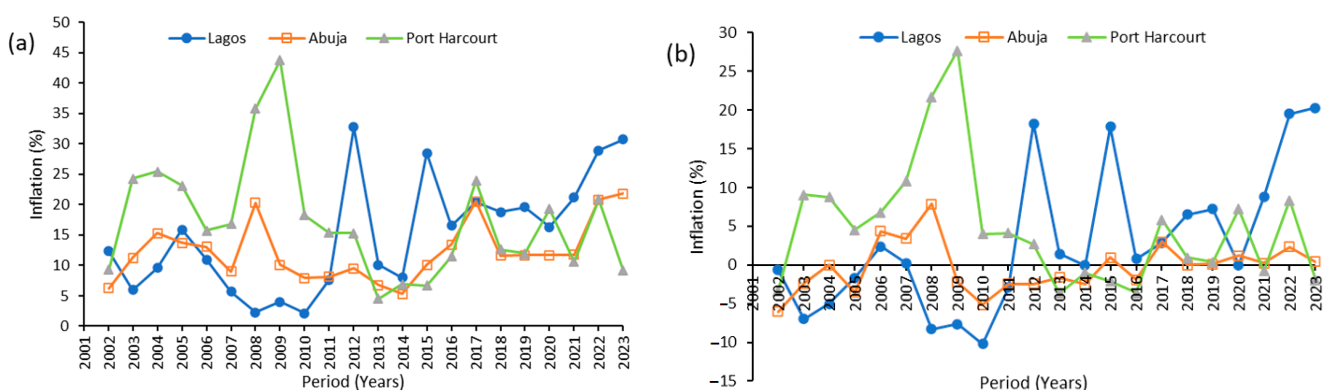

Figure 10. Comparative plots for the investigated property type (block of flats) in the three study locations showing the (**a**) nominal and (**b**) real rate of return.
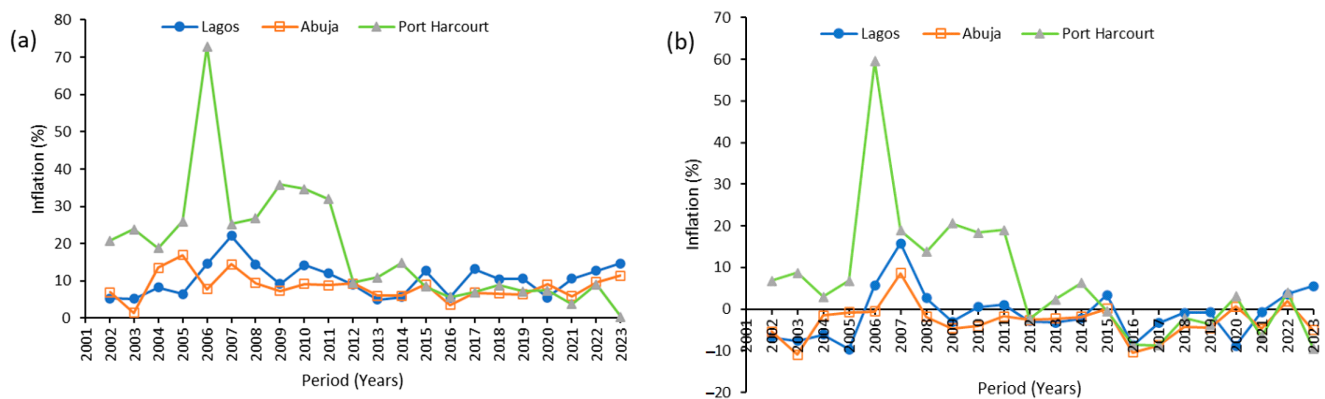
Figure 11. Comparative plots for the investigated property type (detached) in the three study locations showing the (**a**) nominal and (**b**) real rate of return.
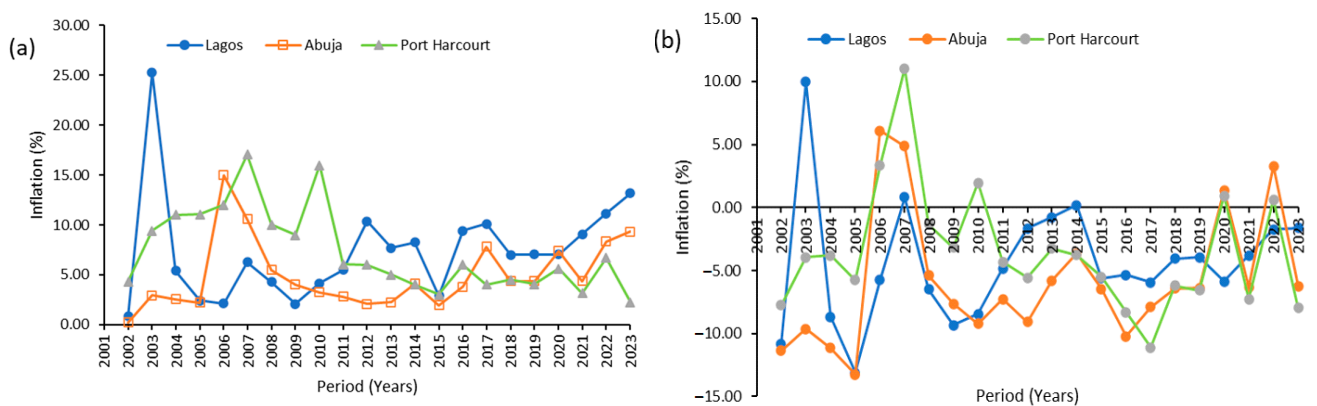

Figure 12. Comparative plots for the investigated property type (office space) in the three study locations showing the (**a**) nominal and (**b**) real rate of return.

4.8. Inflation-Hedging Dynamics of Real Estate Investment Returns

An understanding of the inflation-hedging dynamics of real estate returns is provided using the computations presented in Table 5. The tabulated data in Table 5 depicts the possibilities of the returns of the three study areas. It provides the inflation-hedging capability of real estate investment rental returns. It provides the absolute and real returns for the various locations considered in this investigation. For instance, Table 5 depicts the possibility that the return of a duplex in Abuja is high against the inflation component. A duplex is a partial hedge against actual inflation and a paradoxical hedge against expected and unexpected inflation, as shown in Table 5. This means that the return on duplex property in Abuja is just a partial hedge against actual inflation, not against expected and unexpected inflation. The unexpected inflation R-square is 82.55%; whereas, the actual inflation R-square is 14.38%. Unexpected inflation accounts for 82.55% of the fluctuation in the return on duplex value in Abuja, according to the implications of R-square. The return on the duplex property type in Lagos exhibits counterintuitive hedging features for all inflation components, as shown in Table 5. Actual inflation had the lowest R-square while unexpected inflation had the highest. This implies that inflation components account for between 03.36% and 62.81% of the volatility in the return of duplex property in Lagos.

Other factors impacting the return of duplex property in Lagos outside inflation influence the actual inflation of duplex return. Table 5 also demonstrates that duplex returns in Port Harcourt are a complete hedge against actual inflation, a partial hedge against expected inflation, and a perverse hedge against unexpected inflation. Actual, expected, and unexpected inflation had R-square values of 91.43%, 91.83%, and 83.16%, respectively; in addition, the inflation component explains the difference in the return of duplex property in Port Harcourt. Port Harcourt provided a complete inflation hedge. The

return on duplex properties in Port Harcourt was a full hedge against inflation. As a result of this, Port Harcourt real estate investors who invested in duplex property at the time of this study have a complete hedge against actual inflation.

Table 5. Inflation hedging capability of real estate investment rental returns.

Location	Property Type	Inflation Component	Constant	Coefficient Beta	R Square	*p* Value (Prob)	Type of Hedge
Abuja	Duplex	Actual	2.5163	0.3805	0.1438	0.5856	Partial
		Expected	8.0093	−0.6270	0.2425	0.1762	Perverse
		Unexpected	12.5561	−1.0282	0.8255	0.1419	Perverse
Lagos	Duplex	Actual	14.2812	−0.4792	0.0336	0.54	Perverse
		Expected	20.3785	−0.9690	0.5251	0.3137	Perverse
		Unexpected	1.4941	−1.3985	0.6281	0.1335	Perverse
Port Harcourt	Duplex	Actual	52.3089	0.5975	0.9143	0.4148	Complete
		Expected	34.2517	0.1323	0.9183	0.6617	Partial
		Unexpected	30.7895	−1.2144	0.8316	0.1906	Perverse
Abuja	Block of Flats	Actual	10.4450	0.5633	0.8504	0.3727	Complete
		Expected	9.6375	0.6586	0.8637	0.0693	Complete
		Unexpected	13.6477	0.8440	0.6861	0.2584	Complete
Lagos	Block of Flats	Actual	8.1290	0.0319	0.0004	0.9608	Partial
		Expected	8.0597	0.3492	0.7322	0.6183	Partial
		Unexpected	9.6033	0.4291	0.7443	0.0266	Partial
Port Harcourt	Block of Flat	Actual	4.6143	0.3523	0.834	0.9779	Partial
		Expected	4.0165	0.56763	0.7665	0.5774	Complete
		Unexpected	24.9450	−1.4788	0.665	0.402	Perverse
Abuja	Detached	Actual	0.6588	0.1881	0.2221	0.4848	Partial
		Expected	6.8729	0.3495	0.5575	0.1809	Partial
		Unexpected	2.3094	0.3391	0.7614	0.8419	Partial
Lagos	Detached	Actual	12.8077	−0.7111	0.5232	0.01	Perverse
		Expected	−0.9030	−1.0544	0.9414	0.0432	Perverse
		Unexpected	13.3095	−0.6400	0.5526	0.0302	Perverse
Port Harcourt	Detached	Actual	−2.9513	−1.8374	0.4847	0.0797	Perverse
		Expected	9.5505	0.1803	0.0696	0.7903	Partial
		Unexpected	5.1051	−3.1645	0.8249	0.0862	Perverse
Abuja	Office Space	Actual	−4.2614	0.6854	0.6176	0.0687	Complete
		Expected	2.6834	0.3872	0.4808	0.2521	Partial
		Unexpected	0.7318	0.1193	0.4163	0.778	Partial
Lagos	Office Space	Actual	−89.2457	0.9791	0.8967	0.0406	Complete
		Expected	6.0861	0.5268	0.1869	0.45	Complete
		Unexpected	−3.6257	1.0047	0.4867	0.4448	Complete
Port Harcourt	Office Space	Actual	1.7103	0.7729	0.7725	0.0287	Complete
		Expected	9.7592	−2.1898	0.8438	0.0206	Perverse
		Unexpected	11.4538	0.9347	0.686	0.2699	Complete

This study backs up the findings of the earlier study of Zhou et al. [87] that commercial real estate is a hedge against both predicted and unexpected inflation, unlike the observation of Ekemode [44], which claim that it provides partial inflation protection. This study also contradicts Bello's [7] findings that properties do not have inflation-hedging features against expected inflation. The study explores the hedging capabilities of properties that are traded in the market. These markets are so dissimilar as variations exist in the different markets within the country. The selected properties are not compared but explored to determine which of the properties has a good hedge within each market. Moreso, these variations exist because the markets are dissimilar in terms of population, presence of real estate practitioners, location, and coverage. This is validated using a recent study on commercial property by Umeh and Adilieme [88], which shows that one can compare inflation-hedging properties of buildings traded in markets that are so dissimilar among them, such as the Nigerian property market, but it depends on the region considered and the characteristics of the study under focus.

The rental returns on a block of flats in Abuja are completely protected against actual, expected, and unexpected inflation. The actual, expected, and unexpected inflation have R-square values of 37.27%, 06.93, and 25.84%, respectively. This result implies that the return will not be affected by inflation. In addition, the returns in Lagos are a partial hedge against actual, expected, and unexpected inflation and a paradoxical hedge against unexpected inflation. As a result, the returns on a block of flats provide a complete hedge against expected inflation. The R-square in Port Harcourt for actual inflation is 83.4%, expected inflation is 76.65%, and unexpected inflation is 66.5%, according to the table. This suggests that, aside from inflation, there are other factors that could influence the rental returns of a block of flats in an area.

This study's findings support the earlier study by Odu [5], which concluded that business investments for commercial properties within Lagos offer a complete hedge against inflation. This could be due to differing study schedules or other unknown variables as it contradicts with a more recent study by Umeh and Adilieme [88]; although, their study only looked at commercial properties in Lagos. Moreso, it follows the theoretical works of Amonhaemanon, et al. [89] that were conducted in Thailand where they observed that the correlation for inflation prediction between property returns and inflation rates is dependent on the status of the economy. Furthermore, the findings of this study corroborate another study conducted in Nigeria by Dabara [90], which concluded that, owing to the localised characteristic of the property market, there is no common ground in terms of the inflation-hedging features of commercial real estate investments.

The data in Table 5 reflect the need for further explanations of the inflation component for returns for a detached property as it was seen that detached property returns in Abuja are the partial hedge against the three inflation components. The R–square value indicates the level of variation inflation components have on the returns of a detached property in Abuja. Also, from Table 5, it was revealed that actual, expected, and unexpected inflation R-square values were 22.21%, 55.75%, and 76.14%, respectively. However, returns for Lagos detached property exhibited a perverse hedge against the three inflation components. This means that owning a detached home in Lagos is not a good way to protect against inflation, whether it is actual, expected, or unexpected. This conforms to the findings of Bello [7], who noted that residential properties do not have perfect inflation-hedging features against expected inflation, actual inflation, and unexpected inflation. While returns on detached property in Port Harcourt are a partial hedge against expected inflation, they are also a perverse hedge against actual and unexpected inflation. The R–square value represents the level of variation inflation has on the rental returns of a detached property in Port Harcourt. The actual inflation is 48.47%, the expected is 6.96%, and the unexpected is 82.59%. The result implies that the contribution of expected inflation on the return of detached property in Port Harcourt is low (6.96%). This is further corroborated by the findings of Osagie et al. [91], demonstrating that various investments across distinct sub-markets respond non-uniformly to inflation rates.

The office space returns for Abuja were seen to have a complete hedge against actual inflation and a partial hedge against expected and unexpected inflation. The R-square of actual inflation is 61.76%, that of expected inflation is 48.08%, and that of unexpected inflation is 41.63%. Also, the return of office space in Lagos exhibited a complete hedge against the three inflation components that were considered in this study. This result implies that for office space in Lagos, inflation components do not have any adverse effect on the returns. Port Harcourt office space return was seen to have a complete hedge against actual and unexpected inflation and a perverse hedge against expected inflation. The R-square indicates the variation inflation components have on the property type. Port Harcourt's return of office space actual inflation is 77.25%; expected inflation is 84.38% and unexpected inflation is 68.6%. This result indicates the contributory factor of inflation components to the return of office space in Port Harcourt.

This is also in line with the findings of Umeh and Adilieme [88] that while the profits on commercial property investments within the study area are decreasing, the inflation rates are rising. Thus, based on the three property markets considered in our study, it has been noticed that they have a varying range of characteristics, from partial, to perverse, to complete hedging. As a result, this study suggests that investors willing to invest in commercial real estate within the studied locations should be mindful of the inflation-hedging capabilities that their proposed investment has and may further investigate other established investment opportunities that have been proven to withstand the long-term impact of inflation. Following the United Nations report, there is hope of economic recovery from inflation for nations that works towards the prospects and available solution [92]. This study suggests that further research study can be carried out in comparison with REITs such as that of US REITs [93–95]. Another suggestion involves the consideration of different components and characteristics of inflation [49,96–99], and then comparing in different countries. This can also involve the inflation hedging portfolio within real estate, such as the Real Estate Securities and Real Estate Investment Funds [100–106]. Lastly, the relationship between stock markets and inflation hedging could also be considered [107–113].

5. Conclusions and Recommendations

This study undertook the economic analysis of the inflation-hedging dynamics of real estate investment's annual returns generated from some selected property types in Abuja, Lagos, and Port Harcourt. Findings revealed that the annual rental return of the property types exhibited a positive return all through the study areas. As seen in this study, a Port Harcourt duplex exhibits the best investment performance, with a coefficient of variation (CV) of 0.33; meanwhile, this is followed by a block of flats in Abuja, with a CV of 0.40, compared to other locations. Considering the action of inflation in the economy, Abuja duplexes still outperformed other property types in the different locations. Unlike other property types in different locations, it shows an attribute of hedging against inflation more than others, thereby making it a better investment option. The annual return on a Port Harcourt duplex was a comprehensive hedge against the three components of inflation. While some properties in the chosen location are completely hedged, others are only partially or perversely hedged. This proved that the widely held belief that real estate is usually a good inflation hedge is not always true. Thus, this study will enable investors to determine which property types effectively hedge against inflation. Accordingly, the Nigerian government should implement policies to reduce and keep the inflation rate at a single digit to reduce the volatility of real estate investments.

In terms of expected return (ER), the duplex outperformed other property types in the different locations, with a return of 39.56%. Results also show that inflation has an adverse effect on the return of an office space for the three locations considered, with the expected return below 1%. A block of flats in Abuja has a complete defence against the three components of inflation, with coefficient betas of 0.5633, 0.6586, and 0.8440, respectively. The return of office space in Lagos also exhibited a complete hedge against the three components of inflation considered in this study. Duplexes and detached properties

in Lagos have perverse inflation hedges, with a coefficient beta less than 0. Since not all the properties assessed in the selected location had a complete hedge against inflation, this invariably means that a real estate investment cannot be completely relied on as one with a good hedge against inflation, as is generally believed. As a result, investors should consider inflation and other investment attributes when making decisions among arrays of investments. This will help guard against the widespread perception that real estate has a hedge against inflation. This paper adds to the existing literature on inflation hedging by investigating the effect of inflation on the real estate investment returns of commercial properties.

This study's limitations in this paper include not presenting a deep critical analysis of methodological choices made in the literature. However further work would be advantageous for discussing the strengths and limitations of using correlation coefficients, regression models, and various proxies for inflation in these analyses. Also, another limitation of this study is based on the risks and uncertainties as the literature review in this paper briefly mentioned the concept of "hedging" as a technique for reducing exposure to danger but it did not elaborate on the potential risks and uncertainties associated with inflation-hedging strategies in real estate investments. Exploring scenarios where these strategies might fail or have limitations would offer a more balanced perspective in future studies. Moreover, the role of real estate in inflation hedging has not been comprehensively explored in this literature review in this study. While the review mentions that "an asset with nominal returns is said to have a positive relationship with inflation", it could delve deeper into the mechanisms through which real estate investments provide inflation protection. Discussing factors such as rent adjustments, property appreciation, and supply–demand dynamics could provide a more comprehensive understanding in future studies. This study recommends that investors should consider a real return as the basis for choosing the right investment portfolio. Also, investors should take into cognisance the existing disparities between different commercial property types and should always carry out feasibility and viability appraisals on proposed real estate investments. Future studies are recommended to understand the economic impact of the changes in government regimes in Nigeria on inflation. The use of deep learning and other training studies could also be considered in understanding the dynamics of inflation. Although, previous studies have been devoted to understanding commercial property's inflation-hedging ability; therefore, future research can be focused on differences in the inflation-hedging ability between commercial properties and residential properties since analysing commercial properties provides a partial view of the beneficial impacts of real estate properties against inflation.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to they are used for more studies. However, some of the data exist online. This data can be found here https://www.cbn.gov.ng/documents/statbulletin.asp (accessed on 6 March 2023).

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