A comparative study on the Inflation-hedging properties of REITs and Common Stocks in South Africa

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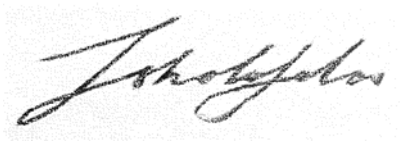
Declaration

I, Tsholofelo Maretela, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in Finance and Investments at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

TSHOLOFELO MARETELA 

Signed at Claremont, Cape Town

On the 30th day of June 2023.

Abstract

The aim of this paper is to examine the ability of South African REITs and common stock to hedge against inflation in the short run from 2014 to 2022. Given the volatile economic environment that South Africa operates in, this poses a risk to the financial market. One of the major risks relates to inflation as it erodes real returns on investments, and this drives the need of gaining clarity on the inflation-hedging characteristics of assets in the stock market.

Studies evaluating the inflation-hedging abilities of real estate and common stock present mixed results and the literature on this comparison is vast but largely excludes African countries. Moreover, the introduction of the REIT regime in South Africa in 2013 has created a new opportunity for real estate investment, which may have different implications for inflation hedging than traditional real estate.

This paper adopts the Fama and Schwert approach, which is based on the Fisher model, to analyse the relationship between inflation and asset returns. The paper considers both actual inflation, measured by CPI, and expected and unexpected inflation, estimated by an ARIMA model.

Using CPI as a proxy for actual inflation, a negative relationship is found between equities and inflation, and a positive relationship between REITs and inflation. These relationships were consistent for both the actual and the unexpected components of inflation. However, both asset classes exhibited a negative relationship with expected inflation. None of these regression results were statistically significant.

Findings imply that neither SA Equities nor REITs can serve as reliable inflation hedges. However, the findings also imply that the relationship between inflation and the returns of these assets is nuanced and may depend on the nature of inflation (actual, expected, or unexpected).

The findings will assist investors in making investment decisions, especially on protecting their wealth from excessive inflation.

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1. Introduction

1.1. Background

A stable and sustainable financial system is essential for efficient economic growth. The stock market plays a vital role in the economy and its performance is influenced by various economic factors. Understanding how the stock market responds to these factors can help accomplish economic growth (Ali, 2013).

Numerous studies have found evidence showing the influence of macroeconomic variables in equity returns. This relationship is important because the objective of a rational investor is to maximize returns and minimize risk. However, preserving the purchasing power of assets across time and realizing returns consistent with investment objectives is a common challenge. And according to Karaloyi and Sanders (1991, cited in Kola, 2017), macroeconomic dynamics like interest rates, industrial production growth, term structure and inflation (expected and unexpected) influence asset returns and are a significant source of risk (Kola, 2017). In relation to gross domestic product (GDP), growth in real GDP can impact the price of securities, and expected cash flow, which can subsequently impact corporate yields (Yunus, 2012, cited in Yahya et al., 2017). Interest rates behave differently, in that as they increase, although the risk-free nominal and discount rate are said to increase, the subsequent result to stock prices is negative. In addition, by way of investor expectations, interest rates are capable of shaping corporate yields (Yahya, Razak, Muhammad, & Gan, 2017).

The stock market is significantly impacted by inflation, as found in various literature articles, and presents a hazard in most emerging economies. The impact of inflation on financial markets in minimizing purchasing power, standard of living and potentially decreasing investment returns, has been of concern to investors, academics, and authorities (Salisu, Raheem, & Ndako, 2020a). Considering the significant impact of inflation on the performance of various assets, a large number of institutional investors incorporate it as a key factor in their investment strategies (Glascock, Lu, & So, 2002a; Lee & Lee, 2014).

The relationship between inflation and stock prices is a complex and contested issue that has been examined by numerous studies. However, the empirical evidence on this topic is inconclusive and varies across different contexts. Moreover, inflation is considered to be a key determinant of stock returns, as suggested by Tripathi & Kumar (2014a), and therefore an intriguing variable to investigate in different market economies.

The equity-inflation relationship is transposed from various theories, with the 1930 Fisher Hypothesis (or effect) being one of the first to explain how nominal interest rates or returns from assets contain market considerations of expected inflation rates. According to Arnold and Auer (2015), the theory is defined as the hypothetical relationship in which the nominal interest rate is an aggregate of expected real return and expected inflation. Thus, the anticipation that equity returns, and inflation have a positive relationship.

Employing capital expenditure, return and output as indicators of real activity, Fama (1981) demonstrated real activity to have a negative relationship with inflation and a positive relationship with stock returns which are found to have a strong negative correlation. Geske and Roll (1983a) discovered evidence supporting the same conclusion regarding the stock return-inflation relationship. Gallagher and Taylor (2002) also reported a negative relationship, but the negative significance was found when inflation is caused by supply innovations (permanent shocks) rather than demand innovations (temporary shocks).

The Proxy Hypothesis, a famous theory by Fama & Schwert (1977), based on the consideration that inflation affects the stock market negatively by reducing the real income of consumers. This leads to lower demand for financial assets, such as equities, and thus decreases the prices thereof. Based on this theoretical framework, the negative correlation between inflation and real economic performance, as well as the positive correlation between equity returns and real economic performance, induce the negative correlation between equity returns and inflation (Tripathi & Kumar, 2014a). Therefore, the theory is founded on the independent relationships between each variable and future projections of the economy (Moores-Pitt & Strydom, 2017).

Another theory worth noting is the Reverse Causality Hypothesis by Geske & Roll (1983). Moores-Pitt & Strydom (2017) describe the theory as an adaptation of the Proxy Hypothesis in further explaining the negative stock-inflation relationship with the inclusion of fiscal and monetary factors. This theory suggests that the relationship between stock returns and future economic activity is correlated to government revenue, implying that government revenue is the driving force behind both inflation and stock returns (Glascock, Lu, & So, 2002a)

Where the above theory considers that stock returns induce adjustments in fiscal and monetary policy, causing opposing changes to inflation as supported by Liu, et al. (1997a), the Inflation Illusion Hypothesis explains the inverse relationship differently. The theory attributes the negative relationship to an inflation error carried out by investors due to the inaccurate use of

nominal interest (growth) rates when capitalizing expected future cash flows (from earnings and dividends) despite periods of changing inflation (Attie & Roache, 2009; Mpofu, 2009).

Despite the variation in markets, periods, and approaches, many studies have provided evidence and theories to support the negative relationship between stocks and inflation. However, as Moores-Pitt and Strydom (2017) have noted, evidence from data sets following the war suggests that this relationship may be indirect, inconsistent, and insignificant, and therefore spurious. Nevertheless, understanding this relationship is crucial for investors and institutions to assess their market position, especially in scenarios of anticipated inflation fluctuations. This can be used to inform investment decisions, which can broadly be categorized as reinvesting, withdrawing, or retaining funds. As stated by Mpofu (2009), being aware of the relationship may be helpful in providing a competitive edge over other market participants. Furthermore, this relationship underlines the capability of the stock market to hedge against inflation, which is defined as the ability of an asset to minimize the probability that the asset's real return will decrease below a predetermined level (Arnold & Auer, 2015).

In African markets, inflation has exhibited a general upward trend that may stem from the disproportionate weight of food in the consumption baskets of emerging markets and the consequent volatility of inflation relative to other regions. This is compounded by the trade-off between high short-term growth potential and instability in the political and financial landscape. In addition, unstable inflation exacerbates risk premiums and undermines the reliability of inflation forecasts (Taderera & Akinsomi, 2020).

Furthermore, the aim of modern monetary policy is to maintain stability in prices as per Reid (2009), which together with central banks that are independent and transparent, are important in improving inflation forecasts. For instance, the South African 3% - 6% inflation target is a SARB monetary policy that aims to manage inflation and make better inflation forecasts for the future (Taderera & Akinsomi, 2020).

In light of this and the capability of inflation to erode the wealth of investors, inflation-hedging assets are viewed to be more appealing than those that do not. According to most empirical studies, such as Bodie (1976, cited in Arnold & Auer, 2015), an inflation-hedging asset is defined as an asset whose return is not dependent on the inflation rate, insinuating that the relationship is positive between inflation and the nominal return of the hedging asset and a perfect hedge is signified by a correlation coefficient of 1, as the movement in prices is counteracted by the asset returns (Arnold & Auer, 2015).

Investors benefit from understanding assets of this type, and various research papers investigating the ability of financial market assets to serve as an inflation hedge have been conducted in various markets, yielding interesting results (Sing & Low, 2000).

The inflation hedging properties of assets vary depending on their inherent qualities. In the financial market specifically, most assets are vulnerable to structural changes and react strongly to economic fluctuations (Salisu, Raheem, & Ndako, 2020a). This study extends the evaluation of inflation hedging properties of assets by focusing on real estate as a securitized real asset. Considering the economic cycle, the boom and bust phases influence the ability of assets to hedge against inflation. Preceding the Global Financial Crises (GFC), stock prices were rising and could comfortably hedge against inflation and according to Salisu, et al. (2020a), following the GFC, they lost their value and hedging ability. That is when the role of Real Estate Investment Trusts (REITs) was observed on the account that various nations adopted the REIT regime subsequent to the different financial crisis (Olanrele, et al., 2020a). The investment vehicle aided in forwarding and fostering growth in various economies, including emerging markets. REITs have also attracted widespread attention from academics and investors because of their dual nature which means that both the real property market and stock market performance can impact the performance of REITs (Zhu, 2018).

1.1.1. History of REITs

Real estate as an asset is characterized by its heterogeneity and diverse asset classes. Largely, property possesses an underlying value with yields resulting from rental income and capital appreciation. And in attempt to compensate for inflation, real estate leases include escalation clauses for both income and expenses (Arnold & Auer, 2015). In the same article, Arnold & Auer (2015) discuss the disadvantages of unsecuritized real estate, summarized below.

The property market suffers from information asymmetry, low transparency, and insufficient comparable transactions. These factors stem from the infrequency of transactions, which reduces market liquidity. This impedes the development of rigorous research and accurate asset pricing or valuations. Investing in property assets requires a large outlay of capital, operates in an inefficient exchange market, high levels of illiquidity, and involves considerable amounts of funds towards transfer, maintenance, management, and capital expenditure costs, necessary in ensuring capital appreciation (Arnold & Auer, 2015). These limitations provide incentives towards listed real estate stocks and the initiation of real estate investment trusts (REITs).

A REIT, according to the SA REIT association, is a corporation that generates income through owning, trading, and developing income-producing real estate assets. According to Kola (2017) and Naidoo (2014), REITs are funds that utilize collective funds from investors to acquire income-producing property or property-related products, affording all investors the opportunity to invest in large-scale, diverse assets. Additionally, they can also be traded on exchange markets, the same way as stocks. And the function of REITs is to manage a portfolio of real estate assets, which involves acquisitions and disposals, while paying dividends to investors (Beracha, Feng, & Hardin III, 2019).

The background of REITs is that they were developed from mutual funds, where the capital from numerous investors is pooled. This ensures investors earn dividends from this investment exclusive of buying, managing, or financing any real estate themselves which is usually a norm for alternatives of direct real estate investment. REITs predominantly generate returns through the ownership and operation of income-producing real estate. REITs, similarly, to stocks, can be traded on the public market and they can invest in securities that are related to real estate, whole loans, cash or fixed deposit, and mortgage-backed securities. REITs are real estate investment instruments that allow investors to own illiquid property assets, while also providing the liquidity and marketability benefits of conventional equity market assets (Kawawa, 2018).

The investment vehicle is segmented in terms of equity, mortgage, and hybrid REITs, with each having subcategories (Laopodis, 2009). According to Naidoo (2014) based on the S&P Dow Jones Indices, Equity REITs are made up of retail, office, industrial, self-storage, residential, hotels and lodging, diversified, health care and specialty REITs. Mortgage REITs include commercial and residential subcategories, and Hybrid REITs invest in an arrangement of Equity, Mortgage and Mortgage-Backed Securities (Naidoo, 2014).

Essentially, REITs allow for increased market participation and provide tax incentives to investment institutions that meet the criteria to be a REIT. According to the document compiled by the South African National Treasury in 2008, the benefits of REITs include the prospects for investors to diversify their portfolios. This is especially given the increased access to the real estate asset which comprises of supplementary classes that range from property type (commercial, retail, residential, etc.), location and industry. Contrary to the illiquidity characteristics of direct property, REITs can be traded the same way as stocks on the securities market, ensuring liquidity and ease of transaction (National Treasury, 2007).

Moreover, companies categorized as REITs are mandated to distribute most of their earnings to investors, which is an advantage to investing in this asset class. The discussion paper National Treasury (2007) also highlights the good governance of REITs, given their compliance with the rules and regulations set by REIT regimes.

Listed property companies have been in existence prior to REITs and although similar, there are criteria that distinguish the two. Different countries have varying regulations regarding REITs, but generally, they are required to obtain and develop property with the intention to operate the asset contrary to just disposing them after development. Another requirement is that the company has a preponderance share of its assets, with a minimum of 75% of the assets being in real estate and distribute (through dividends) 90 per cent of taxable income per year to shareholders (Kola, 2017), but these requirements may differ for different jurisdictions.

1.1.2. South African REITs

In South Africa, REITs were introduced in 2013 to address concerns with the two investment entities: Property Loan Stocks (PLSs) and Property Unit Trusts (PUTs). PLSs and PUTs had different legal, taxation, and legislative structures from REITs. One of the drawbacks of these entities was that they imposed "double taxation" on investors. REITs solved this problem and some PUTs converted into trust REITs, while PLSs became company REITs. Another disadvantage of the PLSs and PUTs is that they were not internationally recognized and therefore did not encourage foreign investment (Kola, 2016). Moreover, REITs are exempt from capital gains tax in terms of immovable real estate disposal, interests in another REIT or those in a controlled real estate company. However, the REIT shareholder has a tax obligation when the shares are disposed of.

In South Africa, the Johannesburg Stock Exchange (JSE) listed REITs are valued at over R250 billion based on market capitalization and have investments in properties across the globe. In terms of impact, the REIT sector is an eminent contributor to the real estate development department by holding some of the biggest tenants such as the Top 40 Companies and the Government (Chihota, 2020). South African REITs are prescribed to have 7 important features:

- Own a property portfolio with a value of at least R300 million
- Maintain debt levels as a percent of gross asset value below 60%
- Generate 75% of its earnings from rental income, owned real estate or revenue from indirect real estate investment
- Appoint a risk-monitoring committee

- Circumvent entering into derivative instruments that are outside of the core business operations
- Distribute a minimum of 75% of its taxable income available for shareholder every year (Chihota, 2020).

Real Estate Investment Trusts are distinguished by their duality as they exhibit features of common stocks and that of the underlying real estate asset (Ntuli & Akinsomi, 2020). Hence, REIT performance is not always consistent to that of the equity or direct property market. Various studies demonstrating this duality have shown irregular findings. For instance, Ntuli & Akinsomi (2020) found varying results in the short and long run, with REIT behavior being more like that of the stock and property market respectively for each period, and a relatively stronger relationship of REITs to the underlying asset. In the findings of the study, the author determined the varying, but direct relationship that exists in South African REITs and the stock market.

Findings from Glascock, et al. (2002a) show segmentation of REITs from the stock market until the early 1990's and a shift in this relationship, with evidence of REITs behaving like stocks prior to 1992. Zhu (2018) echoes similar findings in that REITs, and the underlying asset and equity market respectively have a time-varying nature, and thus their influence on REITs based on the cointegration relationship is not consistent and the variations should be taken into consideration when making predictions. Zhu (2018) brings an awareness that the divergences found in prior research articles on the nature of REITs is because of its everchanging nature, due to the characteristics of the asset actively undergoing gradual development over periods.

1.2. Substantiation of the problem/significance of study

Glascock, et al. (2002a) underlines how existing literature on the interaction between REITs and Common Stock has disregarded the common influences that could impact these relationships, which originate from macroeconomic factors; inflation being one of the major elements impacting the overall real estate market.

REITs have a dual nature that makes them interesting to compare with common stock. However, the results of such comparisons are not consistent across different studies. Moreover, the inflation-hedging abilities of real estate and common stock are also ambiguous, which adds to the difficulty of predicting the behavior of securitized real estate (REITs). Erasmus (2015) provides some evidence that securitized property in South Africa has outperformed inflation and other assets, except bonds, in terms of dividend yields and total returns.

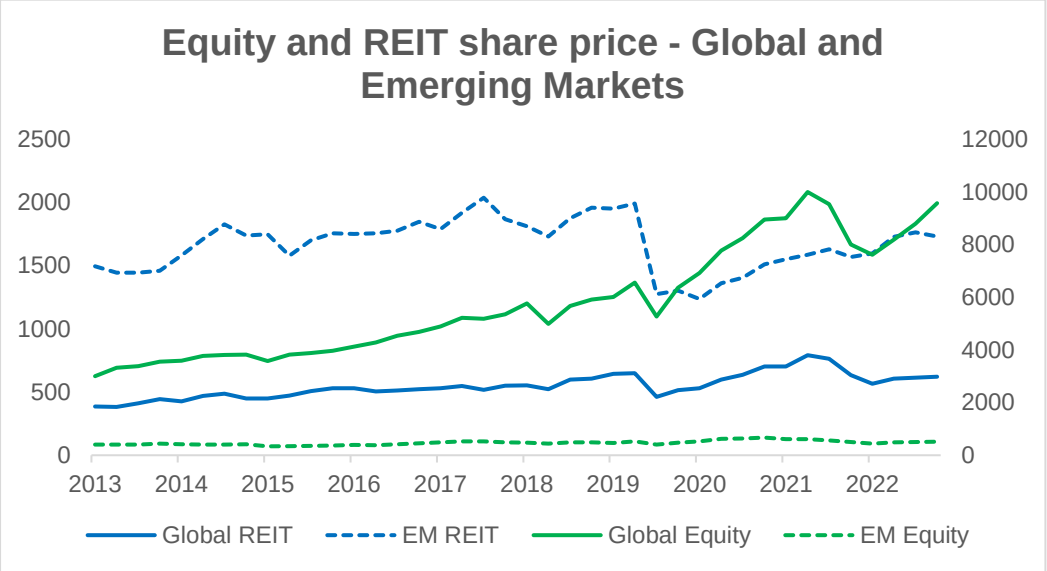
However, the same cannot be assumed for REITs because they are a kind of securitized asset which converts real estate into financial instruments that allow for broader market participation and thus susceptible to market forces. Furthermore, the literature on this comparison is vast but largely excludes African countries.

This gap in the literature motivates the need to examine the relationship between REITs and common stock in South Africa, especially after the introduction of the REIT regime in 2013, which is expected to foster the development of this investment vehicle. Another factor that makes this context relevant is the country's developed financial market, coupled with the volatility of inflation.

When examining the relationship between equities and REITs and inflation, it is not sufficient to rely on a single region or market, as they may have different characteristics, risks and opportunities. As Figure 1 shows, the performance of the financial market can vary due to systematic issues unique to each region, such as political stability, regulatory environment, economic growth and demographic trends (Aisen & Veiga, 2011). Moreover, the maturity of markets in developed and emerging economies also plays a significant role in determining the effectiveness of assets as inflation hedges, as they may have different levels of liquidity, transparency, diversification, and competition. Therefore, by undertaking research in South Africa may enhance the understanding of the topic and provide a more robust and nuanced argument.

Figure 1

Equity and REIT share price - Global and Emerging Markets



(Sourced from Bloomberg)

The literature review will further elaborate on these issues and reduce the literature gap by also considering the effects of expected and unexpected inflation on REITs and common stock over a relatively larger span of data.

1.3. Problem statement

The research problem, given the South African context, is twofold as it pertains to both inflation risk and the lack of research on REITs' inflation hedging capabilities.

The first problem is borne by the volatile economic environment that South Africa's emerging market operates in, which poses a risk to the financial market. One of the major risks relates to inflation as it erodes real returns on investments, and this drives the need of gaining clarity on the inflation-hedging characteristics of assets in the stock market. Which takes us to the second problem, being the magnitude of research conducted on this topic. Despite the various studies that have been carried out on the asset return-inflation relationship, investors and stakeholders are posed with some uncertainty during investment making decisions because there are inconclusive findings. Furthermore, given that the REIT regime was introduced in 2013, literature on REITs in South Africa is limited as a result of data paucity but the period of analysis (2014-2022) provides sufficient context to observe the behaviour of SA REITs in response to inflation.

1.4. Research aim

The research aim is to compare the inflation hedging capabilities of REITs with the stock market in South Africa. The study will use data from June 2014 to September 2022 to analyse how REITs and stocks perform over the 8-year period in an emerging market context. The research will contribute to the literature by addressing the inconsistency and scarcity of evidence on this topic.

1.5. Research objectives

- Ascertain the inflation-hedging characteristics of REITs and common stocks respectively.
- Given total return, compare REITs and stocks in relation to their inflation-hedging properties in South Africa.
- Compare how REITs and stocks hedge against expected inflation and unexpected inflation.

1.6. Limitations

The limitation of this study relates to the lack of a long span of data in the stock market given the relatively nascent REIT regime in South Africa. The study period is from June 2014 to September 2022, which is relatively short compared to various other literature. Although the listed real estate companies were trading in the stock market as PLSs and PUTs, the introduction of the internationally recognized REIT regime in South Africa was only in April 2013.

1.7. Outline of the study

The first chapter introduces the study and offers context for the research question. The background of the problem it outlined, and the goal identified together with a discussion of the importance of the research and the factors that present limitations towards the research.

In the second chapter, a literature review is carried out, and a clear and concise summary of the results is presented. The review assesses academic publications, articles, websites that have previously undertaken research on financial markets, equities and REITs both globally and in South Africa. This assists in identifying areas of study that have not been thoroughly explored and regions where knowledge gaps exist.

The third chapter of the article highlights how the research is conducted by detailing the research design which includes the statistical techniques used, population and sample universe that will be tested, the data collection process and the study's ethical concerns.

Chapter four is dedicated to the research results use the appropriate methodology to compute results for the empirical analysis. The results are discussed in the context of the theoretical framework and inferences are made about the inflation hedging properties of the assets.

To conclude, the study's ramifications, conclusions, and suggestions for further research are presented in Chapter 5.

2. Literature review

2.1. Introduction

This chapter critically examines the existing literature on the topic of analysis. It shows how the research problem and background are informed by various sources that have studied REITs globally and in South Africa. This helps to identify similar studies and their findings, as well as gaps and opportunities for further research.

This chapter on the literature review provides a critical analysis of the existing theories' conundrum. The background to the research indicates the global fascination and extensive research on the area of analysis which has provided volumes of evidence that is sharply divided with, however, limited evidence on emerging African markets. This is not shocking as econometric models that are used to infer strong relations and causalities require lengthy data. As such, given the nascent nature of South African REITs, not much research has been conducted in that area.

The advancement of already existing research in emerging markets is important for investors who aim to maximize returns and minimize risk, where knowledge can aid in understanding the inflation hedging nature of assets. In view of South Africa being the largest REIT market in Africa, important insights into the REIT market are key for the rest of the continent, including countries that are considering the implementation of the regime.

The noticeable differences between REITs and stocks despite their integration are discussed in the literature review as it is a strong setting to assess their inflation hedging properties.

2.2. Theories

This section provides a thorough and critical review of the relevant literature on the topic of inflation hedging. It examines the various theoretical frameworks and empirical hypotheses that have been proposed to explain the nature of the relationship between different financial market assets and inflation. It also traces the evolution and development of these theories over time.

2.2.1. Fisher hypothesis

The equity return, and inflation nexus are transposed from various theories, with the 1930 Fisher Hypothesis (or effect) being one of the first to explain how nominal interest rates or returns from assets contain market considerations of expected inflation rates. The theory is defined as the hypothetical relationship that "the nominal interest rate is composed of both

expected real return (or interest rate) and expected inflation" Arnold & Auer (2015). Thus, the anticipation that equity returns have a positive relationship with the rate of price increases.

Development in this field of study has brought about empirical results that are rather conflicting with the theory of Irvin Fisher. Moores-Pitt & Strydom (2017) further explains that despite the prediction of a positive relationship, evidence to authenticate the theory is infrequent. Widely quoted authors with literature supporting the variance include "Nelson (1976), Bodie (1976), Fama & Schwert (1977), Modigliani & Cohn (1979), Geske & Roll (1983), Gultekin (1983), Ely and Robinson (1997), Feldestein (1980)" as referenced by (Mpofu, 2009; Tripathi & Kumar, 2014a; Moores-Pitt & Strydom, 2017; Hong & Lee, 2011).

2.2.2. Proxy hypothesis

Using capital expenditure, return and output as a measure of real activity, Fama (1981) found it to have a positive relationship with stock returns and a negative relationship with inflation. Using data from the United States stock market, Geske & Roll (1983a) found evidence leading to the same conclusion on the stock return-inflation relation. Authors including Asprem (1987), Chatrath, et al. (1997), Maysami & Koh (2000) and Gallagher & Taylor (2002) found a negative relationship between stock returns and inflation. However, the negative significance was found in the case where inflation is a result of supply innovations (permanent shocks) instead of demand innovations (temporary shocks). According to Tripathi & Kumar (2014a), Tursoy et al. (2008) documented a significant correlation between the stock returns and inflation , money supply, risk premium and term structure of interest in the study on Istanbul's stock exchange and various macroeconomic variables. Conversely, Victore & Kuwornu (2011), Khan & Yousuf (2013) and Tripathi & Seth (2014b) each found a significant positive relationship in their respective studies. The above evidence is sharply divided however, reasons for this interaction has been supplemented by some of the abovementioned authors, with one such reason being the Proxy Hypothesis, a famous theory by Fama & Schwert (1977). The basis is found from the consideration that a rise in inflation increases expenditure on consumer spending which decreases disposable income, lowering the demand for financial assets including that of equities whose prices subsequently decrease. This theory explains how the negative inflation and real activity relationship and the positive equity returns and real activity relationship induce the negative relationship of equity returns and inflation (Tripathi & Kumar, 2014a). The hypothesis is thus supported by the autonomous association among each variable and expectations of movement in the economy (Moores-Pitt & Strydom, 2017).

2.2.3. Reverse causality hypothesis

Another theory worth noting is the Reverse Causality Hypothesis by Geske & Roll (1983). Moores-Pitt & Strydom (2017) describes it as an expansion of the Proxy Hypothesis in further explaining the negative stock-inflation relationship with the inclusion of fiscal and monetary factors. As shown by Moores-Pitt & Strydom (2017) and Anyiwe & Igbinedion (2015) where negative shocks in the market would impact the economy and stock returns negatively, which would have adverse influences on government revenue and the economic climate through unemployment and corporate yields. This leads to decreased tax revenue from both individuals and corporates, and consequently leading to government deficit. This impact on the bottom-line results in the following fiscal policy; increased public borrowing and monetary policy; purchasing of debt and compensating through increasing money supply (Geske & Roll, 1983a). Thus, leading to higher inflation induced by the adjusted supply of money in the market. This theory suggests that the relationship between stock returns and (future) economic activity is correlated to government revenue (Glascock, Lu, & So, 2002a).

2.2.4. Inflation illusion hypothesis

Where the above theory considers that stock returns induce adjustments in fiscal and monetary policy, causing opposing changes to inflation as supported by Liu, et al. (1997a), the Inflation Illusion Hypothesis explains the negative relationship differently. The theory attributes the negative relationship to an inflation error carried out by investors due to the inaccurate use of nominal interest (growth) rates when capitalizing expected future cash flows (from earnings and dividends) despite periods of changing inflation (Mpofu, 2009; Attie & Roache, 2009). Thus, discounting the cash flows heavily through higher nominal rates, given increases in inflation. This has the effect of undervaluing equities during periods of high inflation and overvaluing stocks during periods of low inflation. This which then leads to the negative relationship of stock returns and inflation.

When assessing inflation hedging, it is crucial to consider the performance of financial market assets across different regions given varying systematic issues unique to each region. Additionally, the maturity of markets in developed and emerging economies also plays a significant role in determining the effectiveness of assets as an inflation hedge. The next section of the literature review assesses inflation hedging in different region for both equities and REITs.

2.3. Inflation hedging in equities market

The stock market, also referred to as the equities market involves the issuing of shares which are also known as stocks. And according to Bodie et al. (2005b, cited in Mpofu 2009), the investment vehicle is distinguished by its claim on assets and limited liability that owners of stocks have. The first section focuses on the ability of stocks to hedge against inflation, a study subject distinguished by a large volume of research and a broad range of conclusions. The premise is that common stocks should be able to hedge against inflation, which is often justified on the grounds that common stocks reflect residual ownership of physical production facilities whose values rise with growing prices (or inflation) (Al-Nassar & Bhatti, 2019).

Using the dividend discount model (DDM), as a way to calculate the value of a share, assumes a link between the returns of equities and the inflation rate. As per Stefan & van Rensburg (2019), from the denominator of the DDM in equation 2.1., it is likely that share prices and interest rate movements have an inverse relationship, directly influencing the expected rate of return k.

$$P_{i,t} = \sum_{n=1}^{\infty} \frac{E[D_{i,t+1}]}{[1+k_i]^n} \qquad (2.1.)$$

Where:

$P_{i,t} = The\ price\ of\ share\ i\ in\ period\ t$

$E[D_{i,t+1}] = Expected\ dividend\ receipt\ in\ period\ t+n$

$k_i = The\ required\ rate\ of\ return\ on\ share\ i.$

Despite the denominator's suggested negative association, there are two key justifications for considering stocks as an inflation hedge that are connected to the DDM's numerator, which is a nominal amount. Stocks are first described as real securities because they reflect rights to actual, productive assets of companies. As a result, adjustments in the aggregate consumer price levels should have no impact on the real return on equity investments. Second, investors should profit from unexpected inflation given that most businesses use some level of debt in their funding structures, and the long-term repayment commitments reduce in real value as the nominal amounts paid are fixed (Stefan & van Rensburg, 2019).

Fama & Schwert (1977) offers a useful description that is extensively utilized in empirical studies relating to the hypothesis of inflation-hedging. The concept states that “an asset is a

complete hedge against inflation if and only if its nominal return changes has a one-to-one relationship with both expected and unexpected inflation" (Fama & Schwert, 1977). The model also states that the expected nominal rate of return of an asset is the sum of the expected real rate of return, expected inflation, and unexpected inflation.

Theories of inflation hedging aim to explain the relationship between asset returns and inflation. The various settings of the articles are highlighted to supplement the hypotheses. Thus, the articles are divided into three categories based on their level of economic development: developed markets, emerging market economies, and South Africa, which is examined individually. The assumption is that positive relationships with inflation indicate inflation hedging, while negative relationships suggest the opposite.

2.3.1. Inflation hedging in equity markets - international perspective

Hasan (2008) aims to examine the causal and long-term links among stock returns, inflation, and interest rates in the UK. The author tests the validity of the Fisher Interest Theory in this context. The hypothesis states that nominal interest rates and stock returns should move in the same direction as measurable changes in inflation. This is because investors should eventually be compensated for the inflation premium in asset returns over time. According to the empirical findings, stock returns and inflation exhibit a positive and statistically significant correlation, indicating that common stock is a viable inflation hedge. There is also a bidirectional link between stock returns and inflation, and causation from inflation to stock returns, according to the cointegration and Vector Error Correction techniques, confirming the Fisher effect. Hasan (2008) also demonstrates a long-term consistent link between share prices, interest rates, and price levels, that could be considered to be drivers of long-term stock return. The results imply that stock returns and inflation have a positive and statistically significant relationship.

The article above uses the Fisher hypothesis, which states that the expected nominal rate of return is the sum of the expected inflation and expected real rate of return. And the latter should be independent of expected inflation in an efficient market environment. Fama and Schwert (1977) produce an empirical model specification built on this assumption, which includes an unexpected inflation component. Unexpected inflation is added to account for unanticipated shocks that occur when the market is unable to respond quickly enough to new market information.

Sing & Low (2000) studies real estate and financial assets and their ability to hedge against in Singapore using actual, expected, and unexpected inflation. The period under analysis was divided into different sub-periods based on the prevailing economic conditions, such as stable inflation, financial crisis, low inflation due to reduced consumer spending, and weak demand in the property market. The findings for high and low inflation sub-periods were compared to capture the variation in inflation-hedging quality of different assets (Sing & Low, 2000). Findings show that stocks and the other assets under analysis illustrated mixed findings for the different periods, implying that assets will not always have the same inflation-hedging quality and is subject to change in different periods (Sing & Low, 2000).

Salisu, et al. (2020a) conducted a comparative study which observed the degree to which yields on select financial assets (including stocks) hedge against inflation in the United States of America (USA). Like the above study, Salisu, et al. (2020a) considers inflation hedging properties for different periods as one of the factors influencing the findings which have been shown to vary. Other factors include the inherent properties of the assets, asymmetry in the asset-inflation relationship and the structural shifts that occurred. To take account of the periodic nature of this relationship, the research was segmented between the two periods before and after the Global Financial Crisis (GFC), which was a cause of major changes in financial markets. Regardless of symmetry and shocks, stock returns showed a relatively excellent performance in hedging against inflation. However, only after the Great Financial Crisis did stock returns appear to be a hedge against inflation. This insight emphasizes the need of taking into consideration various economic periods while conducting such a study.

The GFC had adverse impacts on many countries however, Rushdi, et al. (2012) explains how Australia's economy proved to be robust throughout the crisis. The study's main objective is to assess the long-run correlation of stock returns and inflation, making use of expected and actual inflation. The author takes the "multivariate model of real stock returns on inflation, real economic activity and monetary policy into account and assesses if the latter two have any bearing on the return-inflation link" (Rushdi, Kim, & Silvapulle, 2012). ARDL is a test that assesses the long-run relationship, and whether the monetary policy aimed at stabilizing prices (Inflation targeting) had any impacts on this. Empirical findings show a negative and significant influence of actual inflation on equity returns and an insignificant influence of expected inflation, implying that equities in Australia are able to hedge against inflation effectively. Regarding the monetary policy, it shows an insignificant influence on the

steadiness of the long-run stock-inflation nexus in the country (Rushdi, Kim, & Silvapulle, 2012).

Characterizing the ability of assets to hedge against inflation as time-varying is not only exemplified during the GFC, but also during the Second World War as shown by Lee B. S. (2010) who made use of a sample period between 1972 and 2007. The already existing literature focusing on this period showed a positive relationship of equities to inflation in the period prior to the war, and a negative relationship after the war. In an attempt to understand the reason behind this relationship, Lee B. S. (2010) assesses the inflation illusion theory. Because inflation causes investors to discount projected income more heavily, the result is underpriced equity prices during high inflation periods and overpriced equity prices during low inflation periods (Lee B. S., 2010). This leads to a negative stock return-inflation correlation but, because of the inconsistent relationship found prior to and post the war, the nature of the association between equities and inflation cannot be explained by inflation illusion.

The inconsistency found in the inflation and stock return relationship after the war compared to the period before was covered by Gallagher & Taylor (2002) in the endeavor to understand the relationship in the USA. Sources of inflation can be segmented according to demand pull and supply push, and the expected growth of developed economies are impacted more significantly by supply shocks compared to demand shocks. This study analyzed inflation through these two components. Gallagher & Taylor (2002) intends to investigate the 'proxy hypothesis' by examining its ramifications. In a market characterized with inelastic supply, demand shocks influence the expansion of future production minutely or not at all, whereas supply shocks would have a significant influence. Thus, the proxy for projected changes in real activity given the above market economy should be the portion of inflation that is caused by supply shocks. In this analysis, it is found that real stock returns are not significantly correlated with inflation induced by demand innovations solely but have a highly significant negative correlation with inflation induced by supply innovations, which is what the author hypothesized. These findings are not surprising for a developed country like the USA because of the advanced economic environment and subsequent inelastic supply.

The USA and UK are similar in that they are both developed countries however, they differ in terms of world output and world equity returns as stated by Hoesli, et al. (2006), and these factors impact the returns of smaller markets. Carrying out a comparative analysis, this paper assesses the inflation hedging properties of equities (general and small cap) in both the USA

and UK using expected and unexpected inflation with data from 1977 to 2003. As expressed by Hess and Lee (1999) in Hoesli, et al. (2006), stock market yields have a relationship with inflation by way of two forms of disturbances. These being supply (real output) shocks and demand (monetary) shocks with the former presenting a negative stock-inflation nexus, and the latter presenting a positive one. The error correction method is applied to assist in distinguishing between the long-run and short-run relationship. Essentially, this paper finds that asset yields are correlated to the anticipated (expected) segment of inflation in the long-run and not the unexpected segment of inflation once the real and monetary shocks are included (Hoesli, Lizieri, & MacGregor, 2006). To further elaborate, the primitive impact of supply disturbances on stocks is positive and the influence gradually dissipates, whereas the impact on inflation is constantly negative, propelling a negative stock-inflation relationship. Conversely, demand disturbances have a constant but positive influence on both stocks and inflation, providing a positive relationship.

And provided that emerging markets are undergoing transformation of their financial markets and experience different economic conditions, the nature of assets given inflation would have to be assessed in the landscape of these markets.

2.3.2. Inflation hedging in equity markets - emerging markets perspective, excluding SA

Tripathi & Kumar (2014a) undertakes this analysis for Brazil, Russia, India, China, and South Africa, normally referred to as the BRICS Nations, between the years 2000 and 2013 in order to address a gap in the literature that investigates the relationship between stock returns and inflation in emerging countries. Their vastly developing economies and unstable political landscapes have proven to not produce vastly differing results compared to advanced countries. Findings of this study show that in India and China, inflation and stock returns have a substantial positive correlation; in Russia and Brazil, there is a significant negative correlation. The results from the Engle-Granger test over the research period imply that for the BRICS markets, a long-term co-integrating link amongst stock and inflation is not present. Looking at the cointegration results for each individual country, a long-run relationship between stock returns and inflation is found in Russia, India, and South Africa, and not in Brazil and China. Overall, the equity returns appeared to not present an inflation hedge in the long run (Tripathi & Kumar, 2014a).

As of the 1980's, the economic landscape of Turkey has been of interest as it has undergone various levels of inflation ranging from low, moderate, and high. The approach of this study is to assess the broader stock market, individual companies, and assorted industries. Given the various economic environments experienced in Turkey, the study was fragmented according to the different periods. Inflation is assessed in four parts to test the proxy hypothesis: actual, forecasted, expected, and unexpected inflation on equity returns (Aktürk, 2016). Findings indicated the general stock market to be a good hedge against inflation for the different industries. Unexpected inflation proved to have a significantly negative relationship with companies in the service industry compared to the manufacturing one, but that negative relationship was consistent for all the industries. In addition, the findings show that companies with operations in particular industries perform multifariously given inflation, suggesting that the reaction to economic changes is industry specific.

In the attempt to test the Fisher Hypothesis, Al-Nassar & Bhatti (2019) assesses the inflation-hedging capabilities of common stocks in developing economies using 28 countries. Al-Nassar & Bhatti (2019) describes the stock markets of these emerging as having prominent prospects for investors aiming to diversify portfolios. However, the economic landscape where they exist consists of significant inflation risk compared to their counterparts in developed countries due to higher inflation. This is attributable to the sharper interest rates, adverse GDP figures and high food prices which make up a huge contribution to the CPI basket because of the high importance of food (Al-Nassar & Bhatti, 2019). The study distinguishes between the period before and after the GFC and recession. Findings of this paper show that common stocks in South Africa, Singapore, Malaysia, Lithuania, Thailand, and Latvia present a good hedge against inflation. But a perfect hedge is shown in markets in Oman and Vietnam. An interesting finding of this study related to countries that undertake monetary policy decisions that have shown to be effective in attaining price stability in the long run through minimizing nominal interest rates (Al-Nassar & Bhatti, 2019). In addition, money supply fluctuations in these countries were found to be key in powering the long-term inflation rate.

A closer look into African studies on the inflation hedging properties of stocks is assessed because of the upward trend in inflation and differing economic conditions. Research undertaken by Alagidede & Panagiotidis (2010) indicates variations for the different countries under analysis and limitations due to the paucity of data. The study makes use of South Africa and five other countries, and faces the challenge of data that does not span for periods long enough, this being at least ten years of data. Here, a negative and positive relationship between

stocks and inflation in the short and long run respectively is found and the proof of the capability of stock markets in Africa to hedge against inflation. This is interesting, given the general growing trend of inflation in Africa despite the efforts to attain price stability. Moreover, stability tests are carried out for each nation across the reference period. Oil price shocks, crises in developing markets, and different institutional changes are present in the majority of the time periods examined. In the long run, these occurrences may lead to structural changes in the correlation between stock values and consumer prices. These assist Alagidede & Panagiotidis (2010) to find out how the cointegration relationship has altered through time and to detect breaks. The study also examines how stock prices respond to disturbances in consumer prices using impulse response functions, and the findings support the earlier discovery of a long-term positive stock price and consumer price relationship across all markets. This suggests that investors in African economies should anticipate the stock market to protect them from increasing consumer prices, at least over the long term.

These results cannot, however, be generalized for all emerging or developing countries because different markets experience different inflationary movements. In Nigeria, the Nigerian Stock Exchange (NSE) has been in existence since 1960, but due to restrictions on foreign investors and economic and political volatility, the market has been fuelled solely by local perceptions. This was until 1995 when restrictions were removed, opening more opportunities to foreign investments (Mpofu, 2009). Regarding inflation, the CPI basket is made up of mostly food with a share of 64%. Some components of inflation, such like transportation and housing, appeared to have risen at a comparatively quicker rate than other components. This was surprising, considering that Nigeria is an oil-producing country (Mpofu, 2009).

Regarding the nexus between equities and inflation in Nigeria given the above realities, results from Anyiwe & Igbinedion (2015) show a unidirectional causality from equity yields to inflation. The findings also indicate that equities do not possess a significant inflation-hedging quality. Causality is discovered in inflation and government stocks, with causality flowing from government stocks to inflation, supporting the reverse causality hypothesis in Nigeria. Moreover, the empirical findings appear to validate the stocks' weak inflation hedge features, as evidenced by earlier research performed in developed and emerging markets (Anyiwe & Igbinedion , 2015).

Continuing in the African region, Ghana’s market on the other hand is considered small and nascent, given that it was established in 1971, with operation from 1991. The market has

evidenced vast growth through the trading of equities and fixed income securities (Mpofu, 2009). It has since gained global fascination because of the inherent possibilities for investors. For a considerable period from 2000, the economy has experienced steadiness with regards to its macroeconomic variables, including inflation (Owusu-Nantwi & Kuwornu, 2011). This is because of development of key economic players, being financial organizations and capital markets. CPI, used as a proxy for inflation in the study in Ghana is found to have significant straight correlation with equity returns and thus an inefficient hedge against inflation because the correlation indicates prospects of increased yields required for the increased inflation (Victore & Kuwornu, 2011). These results are also consistent to the previous study on Nigeria.

Salisu & Onipede (2019) investigates the stock returns and inflation relationship assessing four major African exchange markets located in including Africa with the earliest data set from 1991 using panel data. It is observed that the average volume of stock returns is higher during the pre-GFC than the post-GFC epoch when all countries are considered. Given the significance of stock exchanges in Nigeria and South Africa, the statistics were estimated individually for the two countries. Generally, inflation is higher during the pre-GFC than the post-GFC due to the economic meltdown from the crisis which adversely affected cash-flow into most African countries. Comparatively, Salisu & Onipede (2019) observed that inflation was more volatile that the stock markets during the pre-GFC period, while the reverse was the case for the post-GFC period regardless of the data sample. Salisu & Onipede (2019) also makes use of the panel quantile regression to check for robustness, which indicated the absence of a relationship between stock returns and inflation in the short run. Salisu & Onipede (2019) find that in the pre-GFC era, stock returns maintained a positive correlation to inflationary increases across the periods analysed (three quantiles) and the positive relationship is also larger for the pre-crisis period than for other sample periods. By implication, stock returns become a good hedge against inflationary pressures to the extent that the four countries maintain a very low inflation environment. Overall, the findings show that "the relationship between stock returns and inflation is episodic in the sense that the direction of the relationship differs between tranquil times and times of turmoil" (Salisu & Onipede, 2019).

Mpofu (2009) confirms, with the use of the Engle-Granger two-step methodology, the positive correlation between stock returns and inflation. However, after accounting for structural breaks, the nature of the relationship is not maintained when assessed using the Johansen cointegration methodology, as a negative relationship is subsequently identified in South Africa, Nigeria, and Botswana. Thus, the contradiction is due to the method used and factors

that were evaluated. Furthermore, structural breaks are shown to have the capacity to change the nature of the correlation and the direction of causality. The author raises an intriguing point and considers that the correlation found suggests that stock market prices may not have fully reflected the inflation rate at the end of the month, because this is not always the time when the data is released, where the latter could express a more robust analysis of expected and unexpected inflation. Thus, instead of month-end stock prices, results for the relationship could alternatively be shown by using announcement date stock prices data (Mpofu, 2009).

2.3.3. Inflation hedging in equity markets - South African perspective

In Africa, the largest stock market is South Africa's Johannesburg Stock Exchange (JSE), which accounts for most (80%) of the continents stock market capitalization and is ranked 18th in terms of the largest markets in the world (Mpofu, 2009). Given this, this market is subject to volatile macroeconomic conditions which makes studies on their vulnerability to economic conditions interesting.

Despite being widely regarded as a nation with financial markets that are well developed, South Africa has been subject to volatility in the macroeconomy because of severe political turbulence, corruption in government, and depreciation of the currency. The need for defense against inflation had added momentum given the history of inflation being more than 20% during the 1980s. In the first study reviewing South Africa, Stefan & van Rensburg (2019) prior research on the inflation hedging capabilities of asset types such as cash, bonds, real estate, and stocks is reviewed by the author. Given the varied tax regimes over time and variations among investment structures, the data utilized Rand values and pretax returns for the primary asset classes spanning from 31 January 1965 to 31 December 2015. The weakest local inflation hedge, according to the results, is stocks. Local cash, on the other hand, offers a better inflation hedge for investors with regards to co-movement with real return. Furthermore, it is often the most heavily taxed asset type when held by an individual. Foreign bond returns, on the other hand, are the only variable with a positive and statistically significant relationship with inflation over the one- and three-year periods analyzed. It is demonstrated that the other asset classes have a negative relationship with contemporaneous inflation. The results of the VAR and the Impulse Response Function indicate that, in response to an inflation shock, local and international stocks react negatively, but domestic cash reacts more significantly. Further, in the long run as per the Engle-Granger cointegration tests, neither of the assets offer a contemporaneous inflation hedge (Stefan & van Rensburg, 2019).

In a 2017 article, Moores-Pitt & Strydom (2017) applies two econometric methods, namely a vector error correction (VEC) model and an autoregressive distributed lag (ARDL) model, to examine how inflation affects the returns of stocks listed on the Johannesburg Stock Exchange (JSE) during the period from 1980 to 2015. The ARDL model is used as an alternative method that can be employed irrespective of the series' stationarity. According to Hancocks (2010, cited in Moores-Pitt & Strydom, 2017), a multivariate examination of macroeconomic variables affecting South African stock prices revealed that the inflation and the stock price index (ALSI) used did not exhibit stationarity and subsequently integrated of the first order. Hancocks (2010) then discovered a substantial negative correlation between inflation and the ALSI using a Johansen's cointegration technique. Contrastingly, Moores-Pitt & Strydom (2017) identified strong indications of cointegration among inflation and stock returns. Cointegration analysis utilizing the VECM indicates that inflation is the primary variable that responds to shifts in equity returns, and that this trend occurs for an extended period. This suggests that possessing shares as an inflation hedge is anticipated to be fruitful over long investment horizons.

van Rooyen & Jones (2019) examines the capacity of individual shares on South Africa's JSE to hedge against inflation during three distinct investing periods. Inflation in South Africa is categorized by its high level and instability, emphasizing the necessity of gaining comprehensive insight on the impact of inflation risk on investment yields (van Rooyen & Jones, 2019). Individual stocks do not behave heterogeneously and thus the impact of inflation on each stock differs by extent and timing (of the impact). The study's findings are ambiguous in that the inflation betas provide no indication of covariance nor real returns. When inflation betas are included, the common hypothesis that inflation and stock returns have a positive relationship is rejected in the South African context. Different inflation periods do not have the same impact on all industries. Industries do not have the same betas and their betas change over time. Sectors with the most pricing and cost management should provide stronger inflation-hedging advantages in the long run (van Rooyen & Jones, 2019).

Eita (2012) examines the association between the South African equity market performance and inflation employing quarterly data from 1980 to 2008. The purpose of the study was to determine if the relationship is positive or negative, as well as the nature of the causality. The proxies employed by Eita (2012) for JSE stock market returns were the ALSI and a gold index and they established a positive correlation between inflation and stock returns, as well as unidirectional causality from inflation when employing gold as a proxy. The findings show that

when gold is used as a proxy, historic and current values of inflation can aid in forecasting stock market yields. When the ALSI is employed as a proxy for stock market returns, the results are different; the discovery is that the causation is bi-directional, implying that the two variables influence each other. Eita (2012) therefore, suggests that past and current inflation rates can be utilized to forecast returns in the stock market. Likewise, historic, and current stock market returns may be utilized to forecast inflation, and stock returns were a hedge against inflation from 1980 to 2008 in South Africa.

Similarly, Khumalo (2013) examined the long-run inflation and stock price interactions using an Auto-Regressive Distributed lag model (ARDL) with quarterly data from 1980 to 2010. They discovered a substantial negative stock price and inflation association, suggesting that stocks plummeted during the inflationary period (Khumalo, 2013). Marx and Struweg (2015) examine whether stagflation impacts the relation of inflation, output, borrowing rates, and returns on stocks. Marx and Struweg (2015) examine the relationship between stocks and inflation and conclude that the former does provide protection against inflation, but this effect weakens when inflation coexists with low economic growth. They interpret their results as follows; "the market gets cheaper as inflation increases and more costly when inflation declines, implying that investors do not feel the market is, in fact, a suitable inflation hedge" Marx and Struweg (2015, cited in Khumalo, 2013).

2.4. Inflation hedging in listed real estate markets

Similarly, to equities, REITs also represent claims on actual, productive assets through rental income and capital appreciation. REITs deviate slightly from other public companies as they accommodate for inflation through escalation clauses and furthermore shareholders are regularly rewarded through dividends. Dividend payout streams of REITs are described as high and steady because of their stable dividend policy driven by the tax incentives. With regards to cash flows, they are possibly the most transparent as compared to other public companies. Thus, better information available to investors.

The implementation of the REIT regime in South Africa was necessary because the real estate investment landscape at the time before implementation displayed drawbacks. As explained in Salisu, et al. (2020a), it was disintegrated, moderately regulated, unable to compete internationally and possessed a restrictive governing framework. It consisted of two kinds of real estate investment vehicles, namely PUT and PLS, and they had different tax treatments (Salisu, Raheem, & Ndako, 2020a).

2.4.1. Inflation hedging in listed real estate markets - international perspective

In the first instance of a developed country's perspective of the inflation-real estate nexus, the following is assessed: "correlation between equity and mortgage REIT returns and inflation in the United States" Adrangi & Chatrath (2004). This analysis investigates the performance of real estate investment trusts (REITs) that invest in equity or mortgage from the beginning of 1972 to the middle of 1999 to assess whether this type of securitized property can provide a reliable protection against inflation. According to the findings, REITs have a negative relationship with unexpected inflation. As a result, during inflationary periods, equity and mortgage REITs do not provide a sense of security. Regarding the association of REITs with the general stock market, Adrangi & Chatrath (2004) observes that the results of the Chow tests support the notion that REITs have been decoupled from the main stock market over more recent periods. Fama's proxy hypothesis is also assessed: One can infer from the assumption that REITs and inflation have an inverse relationship, that REITs and real economic activity have a direct relationship. However, there is no evidence to support this premise. In order to determine a long-term correlation between REIT returns, inflation, and real economic activity both conventional regression tests and cointegration studies are used. Additionally, standard Chow tests are used to determine whether the link between REIT returns, and inflation is stable.

The results can be summed up as follows: the correlation between real REIT returns and the rate of inflation is negative; using Chow tests, this relationship is robust for some of the recent periods under analysis; using cointegration tests, the relationship is robust for the long run; and substantiation from REITs of the Proxy Hypothesis is not present for the entire period under analysis. Even though the analysed REITs do not have strong inflation-hedging capacities, they might nevertheless be used as robust portfolio diversification vehicles in the United States, according to the results.

Another paper in the same geographical landscape of the USA explores the efficacy of different property classes (residential, commercial and farmland) to hedge against inflation. The classes are assessed both separately and as segments of mean/variance efficient portfolios. The study conducted by Rubens, et al. (1989) provides a complimentary extension to the preceding research by amending the timespan assessed and incorporating farmland, commercial and residential property. The asset yields under analysis are split into the capital appreciation and (dividend) income parts. A regression model of the measures of return against actual, expected, and unexpected inflation is done. Subsequent to the empirical research, Rubens, et al. (1989) observes that different assets provide varying degrees of defence against inflation. In this

instance, only the residential asset class provides a robust inflation hedge. Furthermore, the only other asset with some hedging potential is treasury notes. The financial and real assets under consideration have substantial standard errors, resulting in unpredictability in hedging efficacy. According to the segmental results, the income component of total return offers the most hedging efficacy for both residential real estate and Treasury bills. The results of the Livingston survey data on asset hedging effectiveness against expected inflation is comparable to the results against actual inflation however, the findings differ between asset classes, with a margin of them being positive hedges. Only Treasury notes and commercial real estate offer a significantly positive inflation hedge. Assets categorized as indeterminant hedges include all the long-term financial assets, residential property, and farmland. The component of total returns show that the financial assets' appreciation portion performed badly against expected inflation. Rubens, et al. (1989) also found that portfolios with diverse assets offer superior hedging capabilities compared to the long-term financial assets as similarly observed by Adrangi & Chatrath (2004) and has the same sentiments regarding the upside of incorporating property in portfolios because of the low risk per unit of return, and superior protection from inflation offering.

The preserve inflation behaviour is re-examined by "testing for the causal relationships among REIT returns, real activity, monetary policy, and inflation through a vector error correction model" (Glascock, Lu, & So, 2002a). Given that physical real estate provides a significant inflation hedge, and REITs are securitized forms of these assets, an expectation is that REITs will offer a similar inflation hedge, however the previous literature covered by Glascock, et al. (2002a) shows that REITs are rather perverse hedges against inflation, implying no protection to investors against inflation erosion. Glascock, et al. (2002a) speculates that one plausible reason for the above is that the results of the earlier studies is due to spurious regressions and the relative efficiency of securitized real estate in informing processing compared to direct real estate. The author adds on; "the apparent positive relationship between direct real estate and inflation could be attributed to the use of more current (compared to future) valuation or transaction data" (Glascock, Lu, & So, 2002a). This study thus re-examines the negative REIT returns and inflation relationship, while also attempting to establish whether underlying economic functions like monetary policy and industrial production impact the inflation hedge finding. The goals are met by employing a vector error correction model (VECM) to investigate the potential causal relationships between REIT returns, inflation, industrial production, and monetary policy Glascock, et al. (2002a). According to the findings, neither expected nor

unexpected inflation signals REIT returns. Nonetheless, independent of the incorporation of fundamental variables such as monetary policies or industrial production, REIT returns Granger-cause changes in expected and unexpected inflation. Furthermore, changes in the Federal Fund Rate (FFR) represent a small portion of the relationship between REIT returns and expected or unexpected inflation. This conclusion is coherent with prior results that REIT returns are susceptible to interest rate movements since FFR are significantly related to market interest rates Glascock, et al. (2002a). When the authors use nominal inflation (which includes the impact of interest rates) to analyse the causality with REIT returns, causation is not observed. This could be attributed to the observation that causality exists between inflation and changes in FFR, but the same is not reflected between inflation and REIT returns. It is found that changes in how money is regulated and supplied by the authorities affect both how REIT returns fluctuate and how inflation (both expected and unexpected) changes. This implies that the inverse correlation between REIT returns and inflation is not intrinsic, but rather a result of how monetary policies shift. And that the overall findings of this paper show that monetary policies have important impacts on price movements of REITs. The aggregate findings support Darrat and Glascock's (1989) view that monetary policy is important in understanding the apparent perverse inflation results for REITs . These findings also suggest that REITs, in a mixed-asset portfolio can be effective for inflation hedging, which is consistent with the conclusions of (Adrangi & Chatrath, 2004; Rubens, Bond, & Webb, 1989).

A complementary study conducted in the European context is reviewed with the aim of investigating "the short-run and long-run inflation-hedging features of European real estate stocks in both developed and emerging economies from 1990 to 2011 while employing the Fama and Schwert model and a dynamic ordinary least squares (DOLS) regression" (Lee & Lee, 2014). Due to the debt crisis in Europe and the GFC, which have had significant negative effects on the European economy, a great number of research have been conducted to investigate the effectiveness of European real estate equities as inflation hedging instruments. Subsequent to the weakening economic environment that was being experienced, various central banks employed quantitative easing, a loose monetary policy that reduces lending rates and increases money supply through injections and a similar pattern is found in the UK (Lee & Lee, 2014). Long-term, however, a continuation of significant quantitative easing measures could increase inflation expectations, especially during recovery of the financial crisis (Kearns et al. 2010). And indeed, inflationary pressures had been noticeable across several countries in

European. Although many central banks had committed to maintaining low inflation levels, long-term investors favour assets that offer a complete hedge against inflation.

In terms of real estate, the author is of the view that securitised property, specifically REITs, demonstrate distinct qualities in comparison to regular equities (i.e. relatively more distribution pay-out) and expands on the nature of listed property by stating that prior industry analyses have shown a structural shift in the securitized property market and have provided data to support the concept that, since 1992, "securitized real estate behave more like unsecuritized real estate and is better tied to real estate fundamentals" (Lee & Lee, 2014). The findings of this study reference inadequate empirical evidence that strengthen the view of real estate stocks being a sufficient inflation hedge, implying that the hedging of short-run inflation risk would be difficult. Second, significant long-run inflation-hedging outcomes of real estate stocks were observed in the United Kingdom, France, and Germany, indicating in these established countries, real estate stocks do provide an effective long-term hedge against expected inflation. This reinforces the point that real estate stocks in these markets are solid investment opportunities. Third, "a comparison of the long-term inflation-hedging effectiveness of real estate stocks in developed and emerging nations finds that the degree of inflation protection in developed markets is much greater" (Lee & Lee, 2014).

As utilized in the previous study, Sing & Low (2000) conducts this paper on the classical Fama and Schwert framework with this study assessing the hedging characteristics of real estate and financial assets in Singapore alongside three forms of inflation: actual, expected, and unexpected. Singapore's inflation rate, as measured by the Consumer Price Index (CPI), has remained reasonably steady in the ten years preceding the publication of this paper in 2000. Its annual growth rate had been approximately 2%, which is among the lowest in the world. The empirical research tests the inflation-hedging characteristics of a broad variety of real estate assets and financial assets (all-share and all-property share). The analysis is performed over a twenty-one-year period, using quarterly data from 1978 to 1998. Upon the employment of the traditional least square regression analysis approach to model asset returns on inflation variables, low Durbin-Watson statistics are obtained, and this is an indication of positive serial/autocorrelation (Sing & Low, 2000). This study's empirical results show that real estate in general has a better inflation hedging performance than financial assets that only consist of stock and securitized real estate. Retail property can hedge against anticipated inflation significantly, while industrial property is the most effective hedge against both expected and unexpected inflation. The returns on the two real estate assets not only have perfect linear

relationships with the inflation, but they also increase faster than inflation. Sing & Low (2000) argue that industrial and retail property can hedge against both their own inflation risks and the inflation risks of other investments in the portfolio when they are part of a portfolio. The five-year subperiod study indicates that, except for industrial property, which always provides positive hedges against both anticipated and unanticipated inflation, the other assets have a mix of positive and negative coefficients over the different subperiods. This suggests that an assets inflation-hedging capability in one period, may not be the same during a different period. The findings emphasize the significance of an investment's entry and/or exit points in assessing the efficacy of the assets' inflation-hedging properties. Sing & Low (2000) finds that the notion that real estate investments in Singapore are stronger inflation hedges than financial assets is valid.

Globally, the 1990's and early 2000's were marked by low inflation, and this is especially evident in Canada, where inflation averaged 2.0% from 1991to 2007. Hence, this paper investigates the inflation hedging properties of real estate between 1973 and 2007. Moigne & Viveiros (2020) examines the real estate market in Canada for this period with the aim of obtaining the most robust correlation between inflation and real estate. This period provides an ideal setting to discover this as it is characterized by periods of high and low inflation. And like Rubens, et al. (1989), the real estate returns are analysed in their 2 components; income and capital appreciation however, Moigne & Viveiros (2020) provides this analysis outside the usual perspective of the USA and UK. Findings for the short-term show that investing in private real estate in Canada can protect investors from expected and unexpected increases in price levels. The capital appreciation component of returns produced the same findings, whereas the income component is a weak hedge against both components of inflation. Cointegration results for the long-run relationship indicate the presence of a long-term relationship between total and capital appreciation returns and inflation, but not between income returns and inflation. Total and capital appreciation returns, according to the Granger causality tests cause inflation and could thus assist in projecting (future) inflation rates. In accordance with Moigne & Viveiros (2020), the findings support the theory that for the inflation-hedging ability of real estate, investors' demand for inflation hedging investments is more of a priority than income sensitivity to inflation. This paper's findings on the ability of Canadian real estate to hedge against inflation may not apply to other markets, but they are relevant for American private real estate, given the similarities and integration of the two countries' real estate markets. This

paper thus contributes to the evidence on the inflation-hedging potential of American private real estate in academic writing.

Making use of a different approach, this paper investigates "the inflation illusion and inflation hedging impacts on REIT stock prices using the dividend yield decomposition" (Hardin, Jiang, & Wu, 2012). The authors investigate how REITs can serve as a hedge against inflation illusion. Inflation illusion refers to the tendency of investors to misprice assets based on nominal rather than real returns. This topic is relevant for both academic and practical purposes. The empirical study is carried out using a technique where the REIT dividend return is divided into three parts, "a long-run dividend growth rate, an equity risk premium, and a mispricing term" Campbell and Vuolteenaho's (2004). The period under analysis is divided into two sub-periods (1980 to 1992 and 1993 to 2008) to account for adjustments in REIT regulations and REITs demonstrated an inflation hedge in the prior period but not in the latter REIT era. One explanation is that the broader stock market had less influence on REITs during the earlier period, and the real estate's ability to hedge outweighed the impact of inflation illusion. The current REIT period, at the time of publication, is distinguished by substantial capital appreciation and the integration of the REIT industry into the general stock market, including the presence of REITs in large stock indices such as the S&P 500. The latter era, when more institutions invested in REITs, may have reduced their ability to hedge against inflation. The fact that inflation illusion may still be found even when institutional investors are participating in greater numbers demonstrates that even seasoned investors are susceptible to falling victim to this phenomenon.

Overall, the findings show that the REIT market prices exhibit effects of both inflation illusion and hedging. With the former outperforming the hedging impact over the analysis period. This provides a different explanation for the proven relationship between REITs and inflation. When the inflation illusion effect is predominant, despite higher inflation, growth rates are not adjusted to match discount rates by investors. This results in dividend yields increasing, stock prices and returns falling, and the relationship between REIT returns and inflation being negative (Hardin, Jiang, & Wu, 2012).

Provided the above, one may except REITs in emerging markets to perform better than developed markets given that maturity has not been achieved and they are still in the developmental phase. The next sub-section explores this through various articles.

2.4.2. Inflation hedging in listed real estate markets - emerging markets perspective, excluding SA

It is important to conduct more research in emerging markets because the risk of rising inflation is more apparent in those markets than it is in developed countries. This suggests that investors in emerging markets should place a greater emphasis on inflation hedging as a component of their investment strategy than investors in developed markets. The first paper looks at how Malaysian, Philippine, and Taiwanese real estate stocks hedge against inflation in the long run. The aim of this research is to examine the long-term association between real estate stock prices and inflation; however, the existence of cointegration does not guarantee positive relationships long-run in the series, so this method cannot decisively show the inflation-hedging qualities of property. The study also contributes to the scarce literature on the role of real estate stocks as a long term hedge against inflation in emerging markets of East Asia. Liow and Adair (2009) examined the real estate markets in East Asian countries, where investors have shown growing interest and demand for property assets. They noted that these markets offer a wide range of inflationary conditions, which allows for exploring the inflation hedging potential of real estate stocks.

Lee M.-T. , et al. (2011) finds that the expected and unexpected inflation indices show that real estate stocks have a smaller coefficient compared to common stocks. This reveals the likelihood for investors to have more negative yields if they were to invest in real estate during periods of high inflation as per Lee M.-T. , et al. (2011)'s commentary. In addition, the findings of an insignificant variance in the real estate and common stock coefficients suggest that these assets behave in an analogous manner. The empirical research also demonstrates that real estate stocks do not function as a long-term inflation hedge in the East Asian emerging economies analysed. The study's immediate inference is that "real estate stocks in the three developing nations are not an effective long-term investment for investors with long-term horizons where inflation has a greater impact on investment returns" (Lee M.-T. , Lee, Lai, & Yang, 2011).

Utilizing data sourced from the Istanbul Stock Exchange between 1999 and 2004, Erol & Tirtiroglu (2008) assess the inflation hedging capabilities of REITs and common stocks in the Turkey context. They note that REITs have no corporate or income taxes and have liberty over their dividend policies, giving them the financial flexibility to accrue dividends for future investment activities if required. Turkey differs from other established capital markets in that Turkish REITs benefit from significant tax breaks and have greater flexibility in managing their assets. As per legislation, a dividend pay-out obligation is not imposed on the

Turkish REITs. Furthermore, the Turkish economy gives a unique and valuable prospect for Erol & Tirtiroglu (2008) to examine hedging of property stocks in periods of both levels of inflation (high and moderate). Between the 1970s and the early years of the twenty-first century, the country faced sustained hyperinflation, which began to shift course towards a relatively rapid and abrupt decline. Erol & Tirtiroglu (2008) examine how well REITs can hedge against inflation, both expected and unexpected, by applying two models: the CPI-based model of Fama & Schwert (1997) and the Fisherian Direct Causality model (1983). According to the findings, a considerable proportion of the REITs and the ISE REIT Price index hedge against actual and expected inflation and this is consistent over the whole sample period. In both the entire period and the sub-period with high inflation, REITs and the ISE Price index show better hedging performance against expected inflation than the ISE common stock indexes, as the results indicate. Furthermore, results from the Fisher Direct Causality model suggest that a few of the sample REITs have an inflation hedge. The samples of REITs assessed are mostly invested in office, residential, or projects. The inflation protection offered by REITs (residential) may imply a variation in the information asymmetry between Turkey's non-securitized and securitized property markets. REITs, being liquid traded assets, are anticipated to have some benefits over ISE-listed ordinary stocks. In high inflation environments, “not paying corporate taxes and having access to 100% of profits offer REIT managers with substantial sums of cash for investment and asset management purposes” (Erol & Tirtiroglu, 2008).

Olanrele, et al., (2020a) writes about Nigeria’s economic environment in relation to the investment market. The author highlights that the property industry in particular, is not immune to the effects of macroeconomic factors on the general investment market. As a result, REITs, in the midst of economic constraints cannot exist in a vacuum. Following this, the focus of discussion in the subsequent paper is to analyse the diversification and inflation-hedging capability of direct and indirect real estate investments in Nigeria from 2005 to 2014 in order to provide insight for investment decisions. This study makes use of secondary data on average rental rates and total asset values of direct property (residential) investments in Gombe, along with data on dividend and share prices of indirect real estate (Real Estate Investment Trust) gathered from the Nigerian Stock Exchange (NSE) (Dabara, Ogunba, & Araloyin, 2015). Similarly, coupons for Treasury securities were collected and used in the study for the period of analysis. Due to the lack of data on direct property investments, the study period was limited to the years 2005 to 2014.

Findings of the above study reflect the risk-return properties of the assets under review and a direct relationship between the returns from an investment and the inherent risk that corresponds to the investment is found. Relative to the other assets in the study, direct property showed both the highest returns and level of risk of 22.48% and 8.72% respectively. In addition, findings indicated that only the direct real estate investments proved to have both diversification and inflation-hedging capabilities, contrary to indirect property, which had neither of these properties (Olanrele, et al., 2020a).

The second Nigerian-focused research is aimed at finding the reasons for the poor performance of Nigerian REITs together with the lack of activity in the stock market. Inflation, and other macroeconomic variables are assessed because there is no unanimity regarding their direction of influence. The relationship between the above variables and their dividend yields is investigated, together with their combined impact on Nigeria's REIT dividend yield. Investigating the reasons for the poor REIT performance in Nigeria as stated by other authors is the purpose of the paper, in order to also compare the findings with those relating to the impact of the same economic factors, but on better performing REIT markets. The N-REIT's lack of capital gains is a restriction in this study, but the competitive dividend yield is the driving factor. According to the findings, macroeconomic variables have a strong explanatory impact on the value of REITs in the short term (Olanrele, et al., 2020a).

Despite the negative influence of interest rates and inflation on REIT returns which is usual, this causal relationship is negligible in both the short- and long-term. And although market capitalization has a considerable impact in the short run, it does not impact REITs since the relation eventually converges to being positive. The results indicated that Nigeria REIT returns are not adversely influenced by macroeconomic factors, but that it is a market to monitor. This study determined that the lack of trading in the capital market of REITs is a source of caution and a constraint, as other similar markets analysed had strong capital market trading volumes. Nonetheless, (Olanrele, et al., 2020a) believes that the dividend yield from N-REIT is competitive.

These studies emphasize the peril of applying existing market knowledge inadvertently to emerging market information. Nevertheless, they also imply that when investors gain more knowledge, the inflation-hedging capabilities of real estate stocks in the investigated market may strengthen.

2.4.3 Inflation hedging in listed real estate markets - South African perspective

Erasmus (2015) is of the opinion that because of the underdevelopment and inconsistent legal framework that presided over South Africa's securitized property industry, the market had been excluded from international research.

According to Erasmus (2015), both the direct (listed) and indirect (unlisted) property markets in South Africa used two types of instruments: "Property Unit Trusts (PUTs) and Property Loan Stocks (PLS)". The former was governed by the Collective Investment Scheme Act, while the latter fell under the Companies Act. These structures were used to create investment vehicles (direct or indirect) that were appropriate for the objectives of management and shareholders while reducing tax requirements. Until 2013, the South African market did not have a legislative framework for Real Estate Investment Trusts (REITs), and this was despite the fact that they were listed. The Taxation Legislation Amendment Bill was announced in 2013 by the National Treasury, which included a legislative foundation for REITs. A tax concession was designed to resolve the disparities between the PUTs and PLSs relating to tax and to produce an approach that is consistent with global standards. The exception allowed for the conversion of existing listed PLSs or PUTs into the new listed REIT regime (Erasmus, 2015).

PLS returns outpaced PUT returns overall, this being asc ribed to the investment mandates which were less stringent and allowed for larger debt levels and flexible dividend pay-outs. Over the previous ten years, the PLS index had produced more robust returns, with risk-adjusted returns of over 10% above the PUT, producing 6%; moreover, in 2008, half of the capital was diminished relative to the PUTs (Erasmus, 2015). Because the PLS index comprised most of the listed property market, it benefitted from more diversification. However, new SA REIT law was enacted following 2013, bringing it on level with its international counterparts. Furthermore, between 2012 and 2013, the sector's market value doubled (Erasmus, 2015).

With a few exceptions, the SA REIT framework is similar to that of the United States. REITs in both nations can be managed internally or externally, must invest at least 75% of their capital in real estate, and permitted to develop and acquire offshore investments. The main distinction in the structure is that SA REITs have a restriction on gearing of 60%, whereas REITs in the US have no restriction regarding this measure. SA REITs are also required to pay-out at least 75% of earnings to shareholders, whereas US REITs are required to distribute 90% of their earnings (Kola, 2017).

The first research explores the capabilities of South African Commercial Real Estate (CRE) to hedge against inflation. Forecasts for inflation in developing and emerging countries are usually less accurate than those for developed ones. According to Taderera & Akinsomi (2020), the assumption that CRE is an effective inflation hedge ignores the challenges that investors face in predicting inflation trends and adjusting rents accordingly to preserve their returns. They question the validity of this assumption, especially in a developing market context. A central bank that is "independent and transparent, together with an inflation-targeting monetary policy, have been cited as vital components that assist countries better stabilize long-term inflation expectations" (Ha et al., 2019). The South African Reserve Bank in particular has a 3%-6% inflation target in its monetary policy, which speaks well for the country's ability to moderate inflation and more accurately estimate long-term inflation rates.

A description of the SA Corporate Real Estate market is disclosed to provide context to the reader. A common feature of South African commercial real estate (CRE) is that the rental income and value depend on the duration and escalation clauses of the leases across different property types. These leases usually last between three to five years and have fixed rates of increase. Nonetheless, anchor tenants in retail properties and large corporations in industrial and office buildings are eligible for 10-year lease terms. Over the lease term, the rental normally escalates annually at predetermined rates which are driven by the market. "Indexed leases that tie escalation rates to an index are not a common practice in the SA market and rent reviews in this market are infrequent, often only applying to longer leases" (Taderera & Akinsomi, 2020). Furthermore, the leases usually have restrictions on premature termination, implying that the parties are bound into an agreement with predetermined rentals for the duration of the lease, with reversion occurring at expiry of the lease. This can pose an adversity if the inflation expectations happen to be incorrect, and as such, the escalation rates can also only be adjusted at expiry.

For the purpose of identifying the eccentricities of the South African property industry, this article investigates CRE returns and expected and unexpected inflation relationship When examining the long-term relationship between real estate returns and inflation, the VEC model is used to ascertain the extent to which inflation impacts returns. According to this study, CRE investments serve as a short-term inflation hedge. Industrial and retail property both serve as long-term inflation hedges, with retail property providing better protection between the two. Office and industrial space income returns both don't serve as short- and long-term inflation hedges, indicating that rental escalations prevent rental returns from outpacing inflation in the

short- and long-term. This might be as a result of investors being "unable to negotiate on escalation rates that would allow rental returns to exceed inflation because of other macroeconomic factors like interest rates and GDP" (Akinsomi et al., 2018). According to Taderera & Akinsomi (2020), capital appreciation plays a crucial role in CRE's ability to protect against inflation in the long run, even though there is no statistically significant long-run relationship between the capital returns of office and industrial properties. Industrial and retail properties appear to perform better as long-term inflation hedges compared to the other CRE property categories examined in this study, with retail having the superior long-term inflation hedge of the two. In the short term, inflation can erode the value of wealth. Therefore, investors may want to consider the market for listed properties as a way to preserve their wealth against inflationary pressures. The next article under analysis looks at the securitized property market, REITs specifically, with a focus on various macroeconomic variables.

Despite the fact that South Africa is regarded as a country with a well-established financial markets, it has still been susceptible to uncertainty brought on by severe political instability, government corruption, and currency devaluation. The goal of this study is to identify the assets that can best protect investors from inflationary pressures (Stefan & van Rensburg, 2019). Equities, bonds, real estate, and cash are among the assets that are evaluated. All the asset classes, except for foreign bonds, showed a negative contemporaneous correlation with inflation. Foreign bonds had a positive correlation with inflation that was statistically significant for one and three years. With the use of the VAR model together with the impulse response functionality to validate the findings, it is shown that both foreign and domestic stocks, given an inflation shock, react unfavourably. Alternatively, domestic cash shows the most positive reaction to this shock. As per the Engle-Granger cointegration test, none of the assets under consideration (both foreign and domestic) offer a contemporaneous inflation hedge in the long run (Stefan & van Rensburg, 2019).

To emphasize the real estate/property-related results:

In the short and long term, offshore stocks and property are negatively correlated with inflation. International bonds and cash, on the other hand, display a positive connection from a one-year to a ten-year investment horizon, indicating the ability of these foreign stocks to hedge against inflation. Property has a negative inflation coefficient of 0.14, but not significant and the overall findings suggest that local listed stocks perform badly during periods of rising inflation. With South Africa's framework on inflation targeting, "one would expect cash returns to move

with inflation, albeit gradually, as interest rates rise in response to rising inflation over time" (Stefan & van Rensburg, 2019). Following a shock, the ALBI and GOVI returns, as well as, to a smaller degree, listed property, provided a minor inflation hedge (Stefan & van Rensburg, 2019).

Erasmus (2015) examines listed property in South Africa and other assets and compares their inflation hedging capabilities. The study first examines the correlation between inflation and real estate (direct and indirect), then evaluates this relationship with other assets that are accessible for investment. Thereafter, the distinction between hedging against inflation and protection from inflation is made using several measures. Finally, the author analyses inflation in the components of expected and unexpected inflation.

Securitized real estate appears to be preferable for long-term protection from inflation, whereas equities in general are preferable for short-term in this aspect. In the instances where shocks are present, listed property outperformed all of its counterparts in terms of returns. Regarding listed property, the findings of a negative relationship with inflation, together with the similar behaviour to stocks with relatively small market capitalizations and correlation with the overall stock market, is coherent with international studies. When the expected inflation portion is sectioned out, the negative association intensifies and exhibits no correlation with unexpected portion of inflation. The findings regarding the correlation between real estate valuations and bond yields were also consistent with market expectations. The correlation to international listed property was found to be increasing after 2010, indicating a greater integration and engagement in international real estate markets, possibly driven by the 2013 SA REIT law. A study on capital structure provided indications that during periods of high inflation, a fund that had more leverage would perform better as the cost of debt reduced for the debtor. Findings also emphasized that given the impacts of predicted inflation over the long term, listed property reacts more effectively, and it enhanced the argument for assessing inflation protection as opposed to inflation hedging as measured with correlation coefficients.

The literature evaluated by Erasmus (2015) can be summarized as follows. The ability of listed real estate funds in South Africa to hedge against inflation was briefly evaluated in a study by McDonald (2012). The correlation coefficients of the stated indices for PUTs and PLSs are assessed against the CPI for a seven-year period ending December 2009. The interval showed a negative association, although when correlated to CPI from 2010 to 2012, a positive correlation is found in both indexes, showing the inflation hedging capability of property.

Under the assumption that the underlying fundamentals of real estate firms are the primary predictor of long-term returns, a positive market price and inflation nexus is anticipated because the core assets of these companies are the primary signals of systematic returns as the assets have inherent long-dated lease agreements with escalations somewhat linked to inflation. This was invalidated when direct property was demonstrated to have a negative correlation during the same period.

"Listed real estate has the capacity to emulate fundamental components of the performance of direct real estate, however with its own performance attributes, which provide a degree of diversification within a real estate allocation" Haran (2013, cited in Erasmus, 2015). All property indexes outperformed other assets in 2008, and apart from inflation-linked fixed income securities, all other asset classes underperformed inflation. Excluding 2013, inflation-linked bonds outpaced inflation from 2002 to 2012. Thus, demonstrating the strongest assurance of protection from inflation throughout the short and long term, and amid market shocks. In general, securitized real estate performed exceptionally well relative to inflation and other asset classes. In the presence of shocks, listed property outperformed all of its counterparts in terms of returns. The correlation coefficient study of total inflation from 2002 to 2013 revealed that equity and property returns are all inversely correlated, which is consistent with the findings of Bodie (1976) and Farma and Schwert (1977). Local listed property has significant correlations with equities, with coefficients of 0.3 and 0.64 for the ALSI and small caps respectively and the overall SA listed property has not been exempted from capital market volatility, but long-term fundamentals have triumphed, providing strong returns to investors in the face of both expected and unexpected inflation. This was equivalent to, if not superior to, the other asset types covered. Aside from its historically high risk-adjusted returns, listed property offers a valuable addition to any portfolio (Erasmus, 2015).

2.5. Conclusion of the literature review

The background to the research indicates the global fascination and extensive research on the area of analysis which has provided volumes of evidence that is sharply divided with however, limited evidence on emerging African markets. This is not shocking as econometric models that are used to infer on strong relations and causalities require lengthy data. As such, given the nascent nature of South African REITs, not much research has been conducted in that area.

The literature review provides a comprehensive analysis of existing literature on the ability of assets to hedge against inflation. In order to assess the studies effectively, they were grouped

according to topics, the first being studies that examined inflation hedging in equities. These studies looked at the relationship (correlation, causality and cointegration) between stocks and inflation, providing some insight on the assets' inflation hedging ability, and studies that explicitly analysed inflation hedging of stocks. Similarly, the second topic reviewed studies that focused on the real estate industry and its ability to hedge against inflation or merely the relationship to inflation, and a variation of studies were on direct, securitized property and REITs. Each of the topics had sub-topics that segmented the studies according to different market economies, this being developed/international countries, emerging/African countries and South Africa was analysed separately. The literature reviewed is characterized by several differences in methodology, including the use of data from various sources, frequencies, periods, regions, and econometric methods. The literature can however be summarised as follows.

The relationship between equities and inflation was mixed for the three sections, with no distinct patterns found for each. The same was apparent in the studies looking at the relationship between property and inflation. A variation of articles indicated mixed findings in their studies which they identified. For instance, Hoesli, et al. (2006) found mixed findings when supply and demand disturbances were separated. Tripathi & Kumar (2014a) found a positive long-run relationship in Russia, India, and South Africa, but this was negative for Brazil and China, signalling that inflation hedging could be location specific. Research from Salisu & Onipede (2019), Alagidede & Panagiotidis (2010), Eita (2012), and Sing & Low (2000) found the relationship dynamics to be periodic, with varying results depending on either the period before or after the WW, GFC or country-specific inflationary periods. Differences in findings for different stock or asset classes were also found in studies from Stefan & van Rensburg (2019), Hasan (2008) and Rubens, et al. (1989). Other variations in results differed when assessing the short-term and long-term dynamics of the assets' inflation hedging capabilities, methodology used, the components of either total returns (income and capital appreciation) or inflation (Actual, expected, and unexpected). Empirical research in developed economies was more advanced compared to that in emerging economies, with scarcity in research on South African REITs.

The literature reviewed provided an understanding of the existing knowledge from literature that relates to the research question. Inconsistencies in the findings were found together with gaps in research. This provides basis to undergo the empirical analysis that will assist in answering the secondary research questions. The empirical analysis is first guided by the

appropriate methodology chosen. Using the above literature, the method used will be derived from various authors. The selected methodology will ensure a comprehensive approach to data analysis, incorporating quantitative techniques. This will enable a thorough examination of the research question and address any potential limitations identified in the literature review.

3. Methodology

3.1. Introduction

The research problem is addressed by employing a specific strategy and methodology, which are described in this section. The sources of data and the tools for analysis are also explained. The concept of an inflation hedge, following the definition of Salisu, et al. (2020), is an asset that offers returns that are either immune to inflation risk or positively related to inflation rate. Real returns, which are adjusted for price level changes, are a key goal for both retail and institutional investors. However, as the literature review section shows, there is no clear consensus on the empirical evidence and the methodological choices regarding inflation hedging assets. These choices include different data types, frequencies, periods, regions, and econometric techniques, as cited by Arnold & Auer (2015, cited in Stefan & van Rensburg, 2019). This section aims to explain the rationale behind the approach adopted to achieve the research objectives.

3.2. Data and data sources

3.2.1. Population

As defined by Majid (2018), the population of interest is the entire group that the study aims to conduct the research on. In this case, the population is made up of listed securities on the Johannesburg Stock Exchange (JSE), excluding other financial markets such as derivatives and bonds. The study uses a regression analysis to examine the relationship between the monthly inflation figures from Stats SA and the JSE securities. The JSE is made up of different groups of assets and those all make up the population. This is appropriate given that the study is conducted on South African companies and the JSE provides information about those publicly traded stocks.

3.2.2. Sample

This study employs a purposive sampling technique to select a specific group of common stocks from the population of listed companies on the Johannesburg Stock Exchange (JSE) for comparison. The population of interest consists of 350 companies across 10 industries, 19 super-sectors, 41 sectors and 114 subsectors as of September 2022 (Johannesburg Stock Exchange, 2022). The sample of REITs is drawn from the Real Estate sector within the financial subsector, which comprises 20 Real Estate Investment Trusts (REITs). REITs are a

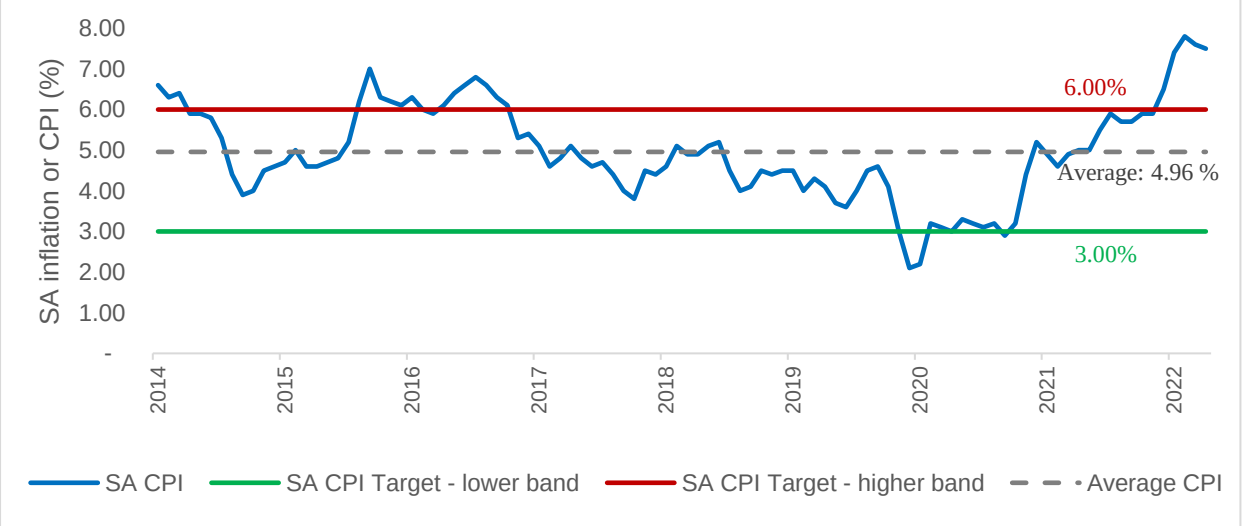
distinct type of property stocks that have different regulatory and financial characteristics from the rest of the population, as discussed in the section on *South African REITs*.

Due to the limited availability of historical data on the South African REIT market, which was established in 2013, this study uses monthly total returns from June 2014 to September 2022 as the observation period. The data sources for the sample are the FTSE/JSE J805 index for the 20 SA REITs and the JSE All Share Index (ALSI) for the 350 companies in the public equity market. The FTSE/JSE J805 index includes most of the former Property Unit Trusts (PUTs) and Property Loan Stocks (PLSs) that converted to the REIT structure in 2013 (Ntuli & Akinsomi, 2020).

3.2.3. Data collection

The Stats SA and Bloomberg databases provide the monthly data utilised for this research. CPI figures are released monthly, usually after the end of the month. Correlations are tested by comparing monthly stock returns to month-on-month CPI returns reported by Statistics SA. Despite the fact that the CPI statistics are provided after the end of the month and may have an impact on market prices, the CPI figures pertain to the period for which they are reported and are thus associated with the stock returns recorded by the relevant indexes over the corresponding periods (Erasmus, 2015). "Inflation is proxied by percentage changes in the South African CPI index" (Stefan & van Rensburg, 2019).

Figure 2
SA Consumer Price Index



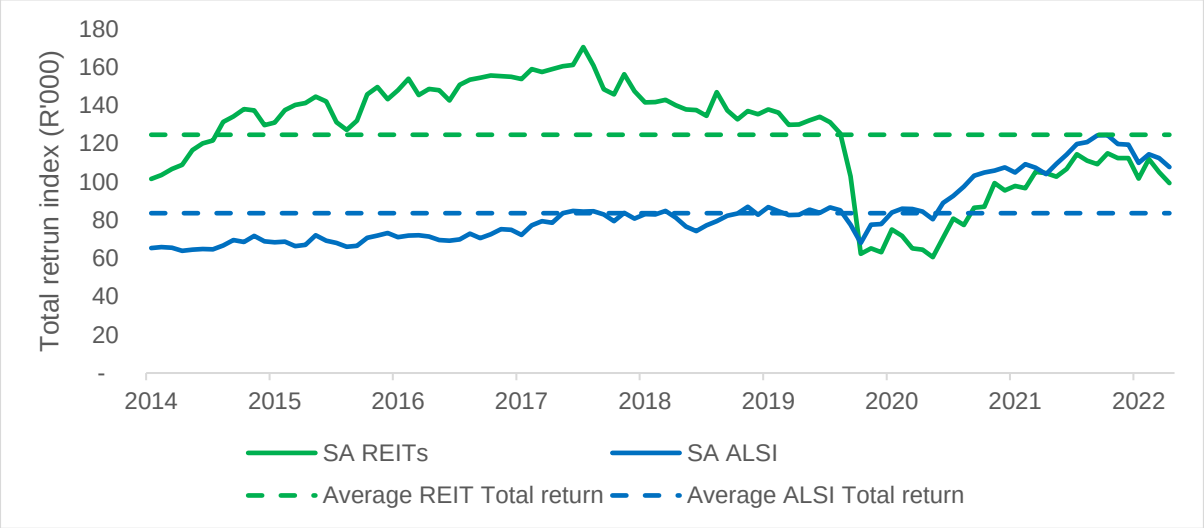
(Sourced from Bloomberg)

The South African Reserve Bank (SARB) inflation target is set at 3% to 6%. Using Bloomberg to source the month-on- month CPI date from June 2014 to September 2022, the average inflation rate for the period of analysis is within this target range, but there are periods where the inflation was outside of this band. Previous studies have examined how different assets can hedge against inflation at various levels. However, the only notable period of high inflation in this study occurred in 2022. Most of the study period experienced moderate inflation. Therefore, this paper does not conduct a separate analysis of inflation hedging for different periods.

Real estate investment trusts (REITs)

The SA REIT Total Return Index is a market capitalization-weighted index that tracks the performance of listed real estate investment trusts (REITs) in South Africa. The index is administered by FTSE Russell and is calculated using the total return methodology, which includes both capital gains and income distributions.

Figure 3
Monthly SA REIT and ALSI Total return (ZAR)

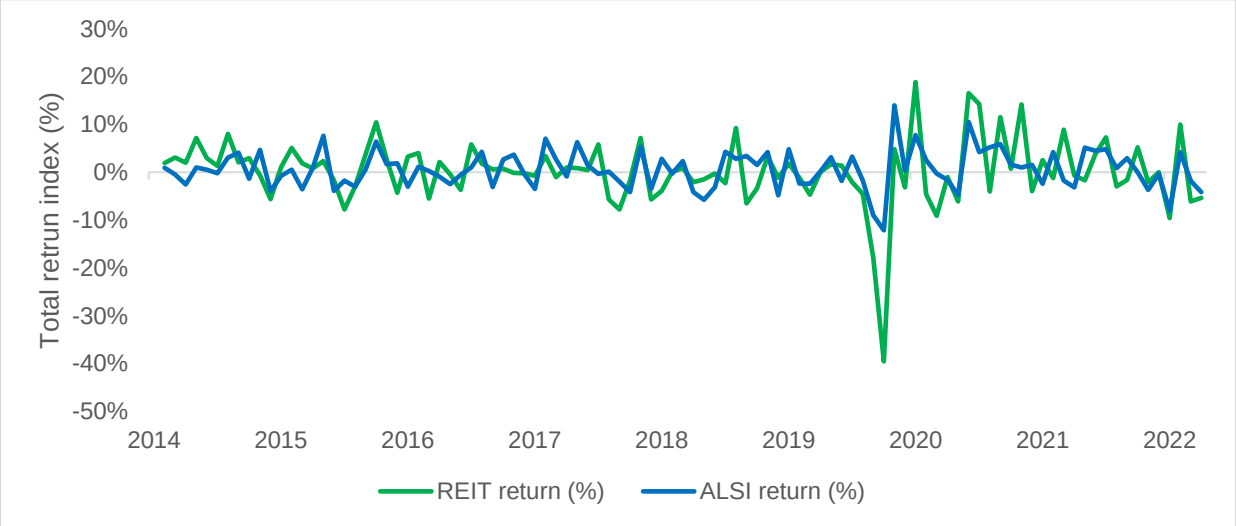


(Sourced from Bloomberg)

The graph above illustrates the monthly total return index of South African REITs and the ALSI from June 2014 to September 2022 obtained from Bloomberg. The REIT regime was implemented in SA in 2013, and since then, the index outperformed the ALSI until 2018 as the real estate market faced challenges from the oversupply of properties in various asset classes. The situation worsened in 2020, when the Covid-19 pandemic imposed restrictions on trade and promoted the work-from-home trend, leading to lower turnovers and occupancy levels for real estate companies. The ALSI, which comprises all other stocks, also suffered a decline

during this period, but REITs experienced a more significant drop. The subsequent period after 2020 is considered as the recovery phase, where companies are striving to return to pre-covid levels. Nevertheless, due to the geopolitical issues, low economic growth, corruption and loadshedding issues in SA, it may take a long time for investors to regain confidence in the overall market.

Figure 4
Monthly SA REIT and ALSI Total return (%)



(Sourced from Bloomberg)

3.3. Research design

3.3.1. Model specification

One of the objectives of the study is to analyse the overall effect of inflation by using a regression analysis that compares nominal returns with actual inflation. This approach allows for a more comprehensive evaluation of the impact of inflation on REIT and the ALSI returns. Thus, the study begins with analysing the comprehensive impact of inflation by regressing nominal returns on actual inflation, as seen below:

$$R_{i,t}^{n} = \alpha_i + \delta_i \pi_t + \varepsilon_{i,t} \qquad (3.1.)$$

Analysing the impact of inflation through expected and unexpected inflation is also important in understanding whether assets can hedge against price increases that are not anticipated by the market. Therefore, the empirical study also makes use of the Fama and Schwert methodology, a development of the Fisher model, which is used extensively to assess the asset return and inflation nexus as observed in several of the empirical research that are assessed. The model is based on Fisher's hypothesis, which states that "the nominal rate of return (I) is

equal to the sum of the expected real rate of return (($E(I_r)$) and the unexpected inflation rate ($E(\pi)$)" (Bin, 2022).

$$E\left(R_{i,t}^{n} \mid \emptyset_{t-1}\right) = E\left(R_{i,t}^{r} \mid \emptyset_{t-1}\right) + E(\pi_{t-1} \mid \emptyset_{t-1}) \quad (3.2.)$$

Where:

$E\left(\mathrm{R}_{\mathrm{i,t}}^{\mathrm{n}} \mid \emptyset_{\mathrm{t-1}}\right) = the\ expected\ nominal\ return\ of\ periods\ t-1\ to\ t, given\ information\ in\ t-1$

$\mathrm{E}\left(\mathrm{R}_{\mathrm{i,t}}^{\mathrm{r}} \mid \emptyset_{\mathrm{t-1}}\right) = the\ expected\ real\ return\ from\ periods\ t-1\ to\ t, given\ information\ in\ t-1$

$\mathrm{E}(\pi_{\mathrm{t-1}} \mid \emptyset_{\mathrm{t-1}}) = the\ expected\ change\ in\ consumer\ prices\ from\ periods\ t-1\ to\ t, given\ information\ in\ t-1$

The Fama & Shwert model will be used to achieve the research objectives and the effectiveness of an investment hedge is evaluated by employing the empirical regression model in equation 3.3. (Fleischmann, Fritz, & Sebastian, 2019).

$$R_{i,t}^{n} = \alpha_i + \beta_i\, \pi_t^e + \gamma_i[\pi_t - \pi_t^e] + \varepsilon_{i,t} \quad (3.3.)$$

Where:

$R_{i,t}^{n} = the\ nominal\ return\ on\ the\ asset\ i^{th} asset\ from\ periods\ t-1\ to\ t.$

$\pi_t^e = the\ rate\ of\ inflation\ expected\ from\ periods\ t-1\ to\ t.$

$\pi_t = the\ realized\ rate\ of\ inflation\ from\ periods\ t-1\ to\ t.$

$\pi_t - \pi_t^e = the\ unexpected\ inflation\ from\ periods\ t-1\ to\ t.$

$\varepsilon_{i,t} = the\ error\ term, \varepsilon_{i,t} \sim WN\ (0, \sigma^2).$

"The parameters α_i, βi and γi are estimated individually for each asset (REITs and ALSI), and these parameters describe the hedge effectiveness of the i^{th} investment with respect to the expected change in inflation (Bin, 2022). As per Fama and Schwert (1977), "an asset is regarded as a perfect hedge when βi = 1, while an investment is regarded as a negative hedge if βi < 0". Furthermore, "the second predictive variable (α_i) of the regression model offers additional information about the nominal asset return's sensitivity to unexpected changes in consumer prices" (Fleischmann, Fritz, & Sebastian, 2019).

Then, the estimated parameters are tested against two hypotheses:

1. $H_0: \beta_i = 0$; $H_1: \beta_i \neq 0$

The first test evaluates the influence of expected changes in consumer prices If the null hypothesis is rejected statistically, "the i^{th} investment is either a positive or negative hedge against expected inflation, depending on the sign of the estimated parameter" (Fleischmann, Fritz, & Sebastian, 2019) (refer to Table 1).

2. $H_0: \gamma_i = 0$; $H_1: \gamma_i \neq 0$

"The second test evaluates the impact of unexpected changes in consumer prices. If the null hypothesis is rejected statistically, it will indicate that the i^{th} investment is either a positive or a negative hedge against unexpected inflation, depending on the sign of the estimated parameter" (Fleischmann, Fritz, & Sebastian, 2019) (refer to Table 1).

Table 1.summarises the above-mentioned dependence of hedging characteristics on the regression coefficient value and direction of changes in consumer prices.(Fleischmann, Fritz, & Sebastian, 2019).

Table 1
Classification of inflation and deflation hedges

Value of β_i, γ_i coefficient	$[-\infty;0]$	0	[0;1]	1	$[1;\infty]$
Hedge Classification	Negative hedge	No hedge	Weak hedge	Perfect hedge	Over hedge

Note: Reprinted from Fleischmann, B., Fritz, C., & Sebastian, S. (2019). Real Estate, Stocks, and Bonds as a Deflation Hedge. *International Real Estate Review*, *22*(1), 1-26. Retrieved from https://ssrn.com/abstract=3661332

3.3.2. Inflation components

The expected and unexpected components of inflation are deconstructed by forecasting the expected inflation component, and thereafter differencing the actual and expected inflation to compute the unexpected component of inflation. "Forecasting based on the treasury bill rate, the Livingston survey, and the Autoregressive Integrated Moving Average (ARIMA) model are three regularly utilized methods of measuring actual inflation, expected inflation (EI) and unexpected inflation (UI)". Furthermore, the CPI measures actual inflation and "unexpected inflation is thus the difference between actual and expected inflation" (Bin, 2022).

$$Unexpected\ inflation = Actual\ inflation - Expected\ inflation$$

As per (Taderera & Akinsomi, 2020), Fama and Schwert (1977) made use of "US Treasury Bill yields as a proxy for expected inflation", however, this estimation approach of expected inflation is criticized for being unable to differentiate between changes in Treasury Bill real yields and the changes in expected inflation rates. Numerous articles such as Sing and Low (2000) and Obereiner and Kurzrock (2012) made use of ARIMA to forecast expected inflation rates rather than making use of proxies such as short-term treasury bill yields. In this empirical study, the ARIMA model is the preferred method for estimating the expected inflation over the period of analysis, as it accounts for the strong influence of the South African government on short-term treasury yields

"A stationary integrated series (I) is one that requires differencing. Auto Regressive (AR) terms are the lags of the stationary variable" (Taderera & Akinsomi, 2020). A way to express the degree of delay in the errors of prediction is the moving average (MA). Moreover, an ARIMA model is "defined by three variables: p, the number of auto regressive terms (AR), d, the number of differences, and q, the number of lags of the error forecast (MA)" (Fleischmann, Fritz, & Sebastian, 2019). The standard ARIMA model representation is denoted as ARIMA (p, d, q), and this notation is used throughout this report (Fleischmann, Fritz, & Sebastian, 2019). Certain conditions must be met before the ARIMA model can be used to forecast expected inflation, and the below are employed to determine whether these specifications are met:

$$\pi_t = \alpha + \beta\pi_t^e + \varepsilon_{i,t} \qquad (3.4.)$$

Where:

$\pi_t = the\ realized\ rate\ of\ inflation\ from\ periods\ t-1\ to\ t.$

$\pi_t^e = the\ unexpected\ inflation\ from\ periods\ t-1\ to\ t.$

$\varepsilon_{i,t} = the\ error\ term, \varepsilon_{i,t} \sim WN\ (0, \sigma^2).$

"The most suitable model is one where α is not considerably different from zero and β is as close to 1 as possible" (Taderera & Akinsomi, 2020).

ARIMA steps according to Baciu (2015, cited in Bin, 2022):

1. Data used:

   Monthly CPI data series from June 2014 to September 2022 for the inflation rate in South Africa

2. The analysis of the series stationarity

   The unit root tests (Dickey-Fuller, ADF, and Phillips Perron) evaluate the series' stationarity. If the series is not stationary, the difference operator is used to correct the data. *d* relates to the order of integration required to achieve a stationary series.

3. Identifying the type of model

   Employing autocorrelation (ACF) and partial autocorrelation (PACF) functions, the parameters (p, d, q), are identified after determining the series' stationarity. The ACF and PACF correlograms are analysed to determine the most appropriate process for the data series.

4. Estimation of the model's parameters

   This step provides guidance about the model's appropriateness. The estimated model is validated through testing and the model's parameters are evaluated using t-tests. The following hypotheses for the model's error variable are tested: a mean of zero, a normal distribution and the absence of autocorrelation. If the errors result in the hypotheses being rejected, the processes is repeated from model identification.

5. Testing whether the ARIMA specification is valid for the SA inflation forecast according to Baciu (2015, cited in Bin, 2022)

3.4. Ethical considerations

It is critical to follow stringent research ethics to guarantee that no harm, embarrassment, or disadvantage ensues to any study subjects. This study is an empirical analysis using secondary data, so no animals or humans are involved. However, the ethical requirements of the University of the Witwatersrand are adhered to. All the literature sources used in the research study are adequately referenced according to Wits Business School guidelines (WBS).

In conclusion, the above methodology presents the research design and methods that are employed to address the research question. It explains the selection of the proxies for REITs and equities, and how they will be compared in terms of their inflation hedging properties. The criteria for classifying different types of inflation hedging is specified, following the existing literature on this topic. Moreover, the procedure for computing the unexpected inflation component using the ARIMA model is outlined, which is suitable for the South African context.

The following chapter will thus make use of the above methodology to compute results for the empirical analysis. The results will be discussed in the context of the theoretical framework with the goal of addressing the gap in literature on this field of study in South Africa.

4. Research results

The methodology outlined in the previous section will be used to compute results for this study. The specified data sample includes historical returns of both asset classes and inflation figures collected from Bloomberg from June 2014 to September 2022 as presented in Table 2. Additionally, the descriptive statistics of the raw data will be examined, including features such as means, standard deviations, skewness, and normality of the series. Econometric tools such as regression analysis and correlation tests will be employed on EViews to analyse the data and infer significant implications. This analysis aims to enrich the literature on the inflation hedging properties of REITs and equities.

Table 2
Asset class indices

Series	Bloomberg Ticker	Abbreviation
JSE All Share Total Return Index	JALSHTR	ALSI
SA REIT Total Return Index	J805TR	REIT
SA Consumer Price Index	SACPI Index	CPI

4.1. Standardization/Transformation

Log transformations are used to standardize the data and transform skewed data to approximately conform to normality. Applying natural logs to time series data is also beneficial for data analysis, especially given that this format ensures ease of use. The data is logged using the below equation:

$$l\_x = log\ (x) \qquad (4.1.)$$

4.2. Descriptive statistics

The descriptive statistics of all the raw data series is recorded and represented in Table 3 with various statistical measures. Skewness indicates the "asymmetry of the distribution of a series around its mean, with skewness equal to zero indicating a symmetric or normal distribution. Positive (negative) skewness implies a long right (left) tail in the distribution" (Mpofu, 2009). Kurtosis assesses the peakedness or flatness of the series distribution, with a normal distribution having a Kurtosis of 3. If the Kurtosis value is less than 3, the distribution is considered to be platykurtic, which means that it is flat in comparison to the normal, but in this case, the Kurtosis for all variables are less than 3. Despite the findings that the REIT and ALSI

data series are not normally distributed, the data analysis process proceeds while acknowledging that this may affect the results of the empirical analysis.

Table 3

Descriptive statistics of the logged series

	CPI	REIT	ALSI
Mean	86.760	12458.950	8357.653
Median	87.350	13238.540	8062.840
Maximum	106.100	17045.700	12435.430
Minimum	70.900	6058.840	6388.590
Std. Deviation	9.635	2748.943	1628.555
Skewness	0.073	-0.738	0.995
Kurtosis	2.045	2.650	2.964
Jarque-Bera	3.890	9.597	16.518
Probability	0.143	0.008	0.000
Sum	8676	1245895	83576
Sum Sq. Deviation	9191.040	7.48E+08	2.63E+08
Observations	100	100	100

4.3. Returns

To perform the analysis, the study employs the logged returns of the data, which are obtained by applying the log difference operator to the time series. This method of calculating returns has the advantage of reflecting the proportional changes in prices rather than the absolute changes, which offers a more precise depiction of behaviour.

4.4. Stationarity analysis

"The unit root tests are conducted for all the series using the Augmented Dickey Fuller (ADF) and the Phillips–Perron (PP) defined at 1%, 5% and 10% levels of significance (LOS)" (Mpofu, 2009). Results are attained for the "tests with an intercept (C), with trend and intercept (T&C), and finally with neither trend nor intercept (None)" (Mpofu, 2009). The trend is differenced and retested for stationarity if it is not stationary at the specified values.

The below tables present the findings of the unit root tests at levels for Actual CPI, REIT Total Returns and ALSI Total Returns. Employing the ADF and PP tests, the results show that with trend, intercept and none, all the series do not have a unit root at the three levels of significance.

Table 4
ADF and PP stationarity test on CPI (differenced log levels)

Variable		DLCPI					
		ADF			PP		
		I	T&I	N	I	T&I	N
Test statistic		-7.8200	-7.8211	0.4635	-7.1595	-7.1393	-4.7257
Test critical values	1%	-3.4991	-4.0554	-2.5918	-3.4984	-4.0544	-2.5888
	5%	-2.8916	-3.4568	-1.9446	-2.8912	-3.4563	-1.9441
	10%	-2.5828	-3.1543	-1.6143	-2.5827	-3.1540	-1.6146
Probability		0.0000	0.0000	0.8127	0.0000	0.0000	0.0000

Table 5
ADF and PP stationarity test on REITs (differenced log levels)

Variable		DLREIT					
		ADF			PP		
		I	T&I	N	I	T&I	N
Test statistic		-8.7311	-8.7430	-8.7768	-8.6959	-8.7056	-8.7432
Test critical values	1%	-3.4984	-4.0544	-2.5888	-3.4984	-4.0544	-2.5888
	5%	-2.8912	-3.4563	-1.9441	-2.8912	-3.4563	-1.9441
	10%	-2.5827	-3.1540	-1.6146	-2.5827	-3.1540	-1.6146
Probability		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 6
ADF and PP stationarity test on ALSI (differenced log levels)

Variable		DLALSI					
		ADF			PP		
		I	T&I	N	I	T&I	N
Test statistic		-10.2173	-10.1670	-10.1036	-10.2253	-10.1741	-10.1028
Test critical values	1%	-3.4984	-4.0544	-2.5888	-3.4984	-4.0544	-2.5888
	5%	-2.8912	-3.4563	-1.9441	-2.8912	-3.4563	-1.9441
	10%	-2.5827	-3.1540	-1.6146	-2.5827	-3.1540	-1.6146
Probability		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

They demonstrate that there are no unit roots for any of the series, rejecting the unit root hypothesis and are thus considered stationary on this criterion. This finding has significant implications for time series analysis and forecasting. Consequently, it becomes possible to apply traditional statistical techniques that assume stationarity, such as the autoregressive integrated moving average (ARIMA) model.

4.5. Forecasted inflation

Following the precedent of previous studies and based on the empirical evidence of this research, inflation forecasting is essential for measuring the impact of unexpected inflation. Furthermore, unexpected inflation is included to account for shocks when the market is unable to respond efficiently enough to new information, hence the requirement of an optimal inflation forecasting model. As discussed in the methodology, the ARIMA model is used after assessing autocorrelation in the CPI series. First the differenced log of inflation series is plotted visually using a correlogram to identify stationarity (using 8 lags**)**. As per the correlogram, the Autocorrelation Function (ACF) is not within the standard error bounds and indicates a dampened sine wave pattern. The Partial Autocorrelation indicates spikes at lags 1, 2 and 6 and subsequently, the series' p and q parameters are determined from the ACF and PACF graphs. This study used the matrix technique in Table 10 of Annexure 1 with a model comprising three AR and three MA processes in order to choose the model that best fits the data: the highest number of significant coefficients, the highest R^2 value and the lowest information criteria (Akaike, Schwarz and Hannan) values. The model that satisfies most of the criterion is selected and chosen following the diagnostic tests: Testing the hypothesis of errors normality and given that the Jarque-Bera test probability is zero, the series is normally distributed. The ARIMA model estimation AR(6) MA(6) is valid for the forecasted (expected) inflation, therefore the time series is shown as with probability values in parenthesis:

$$dlog\ (CPI)_t = -1(CPI)_{t-6} + 1u_{t-6} \qquad (4.2.)$$

$$(0.00) \qquad (0.00)$$

The ARIMA model has coefficients that are statistically significant at the 1%, 5% and 10% levels, as indicated by the probabilities that are below these thresholds.

4.5.1. Unexpected inflation

The above forecasted inflation for the period of analysis is employed to obtain the unexpected inflation portion using this formula:

$$UnexpectedCPI_t = ActualCPI_t - ExpectedCPI_t \qquad (4.3.)$$

4.6. Pearson correlation

The coefficient of correlation is a "measure of the degree of linear association between two variables", that being asset returns, actual, expected, and unexpected inflation as summarized in **Error! Reference source not found.**

The ALSI shows a negative correlation with all three inflation measures (actual, expected, and unexpected), suggesting that it does not provide a good protection against inflation. However, none of these correlations are statistically significant, so we cannot reject the null hypothesis of no linear relationship. REITs also have a negative correlation with expected inflation, but a positive correlation with actual and unexpected inflation. Again, these correlations are not statistically significant, so we cannot draw any definitive conclusions about REITs as an inflation hedge.

Comparing the ALSI and REITs, we find a positive and significant correlation between them. This indicates that REITs behave similarly to other equities and are affected by the same systematic factors. This could also reflect the maturity of the South African REIT market, which has become more integrated with the broader equity market. It would be interesting to explore how this correlation differs when using a proxy for physical real estate instead of REITs.

Table 7

Correlations among the variables with p-values in parenthesis

Correlation (probability)	ALSI	REIT	CPI	Exp_CPI	Unexp_CPI
ALSI	1.000000				
REIT	0.612884 (0.0000)***	1.000000			
CPI	-0.096452 (0.3577)	0.037323 (0.7224)	1.000000		
Exp_CPI	-0.058589 (0.5769)	-0.081447 (0.4377)	0.283886 (0.0058)***	1.000000	
Unexp_CPI	-0.084604 (0.4201)	0.061098 (0.5607)	0.965292 (0.0000) ***	0.023605 (0.8223)	1.000000

Notes: * indicates significance at the 10% level, ** indicates significance at the 5% level and *** indicates significance at the 1% level.

4.6.1. Hedging against actual inflation

The first regression model tests the hedging ability of REITs and ALSI or general stock market against actual inflation as illustrated in **Table *8*** using Equation 3.4:

$$R_{i,t}^{n} = \alpha_i + \delta_i \pi_t + \varepsilon_{i,t} \qquad (1.4.)$$

Table 8
Regression results for actual inflation

Dependent variable	$\boldsymbol{\alpha_i}$	$\boldsymbol{\delta_i}$	R^2	Durbin-Watson
ALSI	0.0084	-0.8237	0.0069	2.1068
	(0.1459)	(0.4135)		
REIT	-0.0019	0.4094	0.0005	1.76677
	(0.8630)	(0.8297)		

Notes: * indicates significance at the 10% level, ** indicates significance at the 5% level and *** indicates significance at the 1% level.

The regression results in Table 8for Actual CPI and the ALSI indicate a negative coefficient for actual CPI and REITs indicate a positive coefficient with actual inflation, thus an inflation hedge however, the coefficient is not significant at any level. This suggests that ALSI and REITs are not contemporaneous hedges against actual inflation.

4.6.2. Hedging against expected and unexpected inflation

Equation 3.3 in the Model specification subsection provides the empirical model with which inflation hedging using expected and unexpected inflation is conducted against the two asset classes. The regression results are summarized in **Table *9*** and indicate:

Table 9
Regression results for expected and unexpected inflation against the differenced log of ALSI and REITs

Dependent variable	$\boldsymbol{\alpha_i}$	$\boldsymbol{\beta_i}$	$\boldsymbol{\gamma_i}$	R^2	Durbin-Watson
All Share Index	0.0147	-2.1967	-0.8799	0.0103	2.1071
	(0.4034)	(0.5906)	(0.4294)		
REITs	0.0229	-6.0498	0.12529	0.0106	1.7740
	(0.941)	(0.4312)	(0.5492)		

Notes: * indicates significance at the 10% level, ** indicates significance at the 5% level and *** indicates significance at the 1% level.

As shown in Table 9, the coefficients indicate that the relationship between Expected and Unexpected CPI and the ALSI is negative, as well as the relationship between REITs and Expected CPI, while the relationship between REITs and Unexpected CPI is positive. However, none of these relationships are statistically significant. This implies that neither ALSI nor REITs can hedge positively or negatively against Expected or Unexpected CPI. Since the relationships are not significant this may suggest that inflation does not affect the total returns of these assets.

The correlation matrix and the regression analysis show the same patterns for both ALSI and REIT returns. The Actual and Unexpected CPI have a relatively higher correlation, so the regression analysis for Actual CPI and Unexpected CPI with the ALSI and REIT time series produce similar results.

The correlation and regression results offer valid insights into the listed property and equity market, which is the main implication of the above findings. The lack of significance in the results could reflect the study's limitations, such as the relatively short data span used, since the REIT regime was only introduced in 2013 in South Africa. This opens up opportunities for further research, using different proxies and methods, but the results are still useful for investors and institutions who want to preserve their wealth.

5. Discussion and conclusion

5.1. Introduction

This research report has explored the topic of inflation hedging from a South African market perspective, which is an under-researched area in the literature. The main objective of this study was to compare the characteristics of REITs and equities in terms of their ability to hedge against inflation in the South African market. This chapter provides a summary and a discussion of the main results and implications of this study, as well as its limitations and recommendations.

5.2. Summary of Results

The inconclusive findings of various international studies on inflation hedging create some uncertainty for investors and stakeholders during investment making decisions. The results of this study are as follows:

The coefficients of the assets regressed against actual inflation (CPI) produced different results, with equities having a positive coefficient and REITs having a negative coefficient, but the results were not statistically significant, meaning that these relationship coefficients may not be strong enough to be considered reliable. The coefficients of both assets regressed against unexpected inflation were negative, but the results were also not statistically significant. In the case of unexpected inflation, the coefficient was negative for equities and positive for REITs. This could indicate that REITs are better protected from unanticipated inflation caused by factors such as geopolitical issues and pandemics. The correlation matrix and the regression analysis show the same patterns for both the Equity and REIT returns. The actual and unexpected CPI have a relatively higher correlation, so the regression analysis for actual CPI and unexpected CPI with the ALSI and REIT time series produce similar results.

Overall, the results of this study suggest that neither the SA Equities nor REITs are effective inflation hedges. However, the study also suggests that the relationship between inflation and the returns of these assets is complex and may vary depending on the type of inflation (actual, expected, or unexpected).

One limitation of the regression analysis is that it relies on historical data. REITs and equities may behave differently in the future than they did in the past, depending on various factors. For example, the Total Return proxy used in this study reflects both dividends and capital appreciation, which are subject to market sentiments and may not represent the true value of

the assets. Future research should further investigate the relationship between inflation and the returns of these assets using alternative proxies in order to confirm the results and better understand how the assets can be used to manage inflation risk.

Glascock, Lu, & So (2002a) assesses other financial markets but similary breaks down inflation between its two components. The results were consistent in the regard that neither expected nor unexpected inflation signal REIT returns.

An appropriate article to compare findings to is that of Erasmus (2015), who examined listed property in South Africa and other assets and compared their inflation hedging capabilities. The results were also consistent, as the author found that listed property had a negative relationship with inflation. Additionally, a correlation coefficient study of total inflation from 2002 to 2013 revealed that equity and property returns were all inversely correlated, which is consistent with the findings of Bodie (1976) and Fama and Schwert (1977), but not with the current study.

This study's findings indicate that investing in the equity market and securitized real estate during different periods of high inflation would result in returns impacted by factors other than inflation as this relationship is inconclusive. Moreover, the findings highlight the inconclusive nature of the existing literature on this research problem, but contributes to the body of knowledge in this field of study in South Africa and offers a foundation for further research on the inflation hedging properties of different assets in the financial market.

5.3. Policy implication and recommendations

In terms of the importance of this study in assisting investors in making decisions about protecting their wealth from inflation, it is discovered that REITs and equities do not indicate any kind of influence from inflation, suggesting that they perform independently from inflation. Managers of investment funds, whose holdings may suffer from inflation, could find this of particular interest.

Although REITs do not offer any protection from inflation, investors would be better off investing in direct property, where leases have escalation clauses that are targeted at protecting from rising prices involved in managing real estate.

Another implication is that in view that the performance of some investments funds is benchmarked by a rate relative to CPI, this study provides an indication of asset classes' that move in line with inflation. This is in addition to the assessment by investors on whether these assets' returns are above the said rate (CPI-linked benchmark). Another implication is that

investors can look to offshore investments, as to enhance the inflation hedging abilities of their portfolios.

Given that the study does not assess the long-run inflation nexus, investors would have to be weary that these findings may not necessarily be consistent for a longer time horizon.

5.4. Recommendation for further research

A potential extension of the study would be to explore the asset-inflation nexus using alternative inflation proxies. In this study, the consumer price index of South Africa is used as a proxy for inflation. Nevertheless, alternative proxies, such as the producer price index PPI, can also be used to comprehensively explore the relationship.

Alternative methodologies could also be applied to enhance the study. In addition to cointegration testing, some recent research has incorporated ARDL testing. Considering that ARDL does not necessitate that the assessed time series have the same order of integration, the relationship may be examined more thoroughly using this tool (Kawawa, 2018). In addition, empirical research on the long-run relationship of inflation would be beneficial for investors with long-term investment horizons.

5.5. Conclusions

The empirical findings of this comparative study achieved the aim of minimizing the gap in literature on South Africa by providing a comprehensive analysis and comparison of the inflation hedging properties of REITs and other equities through the All-Share Index. And the objectives of the study are met despite the limited data available for analysis given the nascent REIT structure in South Africa.

The research results obtained from this study offer valuable insights for investors, institutions and other academics who are interested in inflation hedging strategies. Moreover, the results also suggest some directions for future research in this area, such as applying different methodologies and research designs to test the robustness and generalisability of the findings.

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Annexure 1

Figure 5
Correlogram of the differenced log of inflation series using 8 lags

Date: 06/27/23 Time: 11:50
Sample (adjusted): 2014M07 2022M09
Included observations: 99 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.265	0.265	7.1658	0.007
		2	-0.191	-0.281	10.929	0.004
		3	-0.083	0.065	11.652	0.009
		4	-0.005	-0.059	11.655	0.020
		5	-0.050	-0.051	11.925	0.036
		6	-0.204	-0.207	16.395	0.012
		7	0.046	0.187	16.624	0.020
		8	0.044	-0.167	16.835	0.032

Figure 6
Time series of the expected inflation forecast using ARIMA

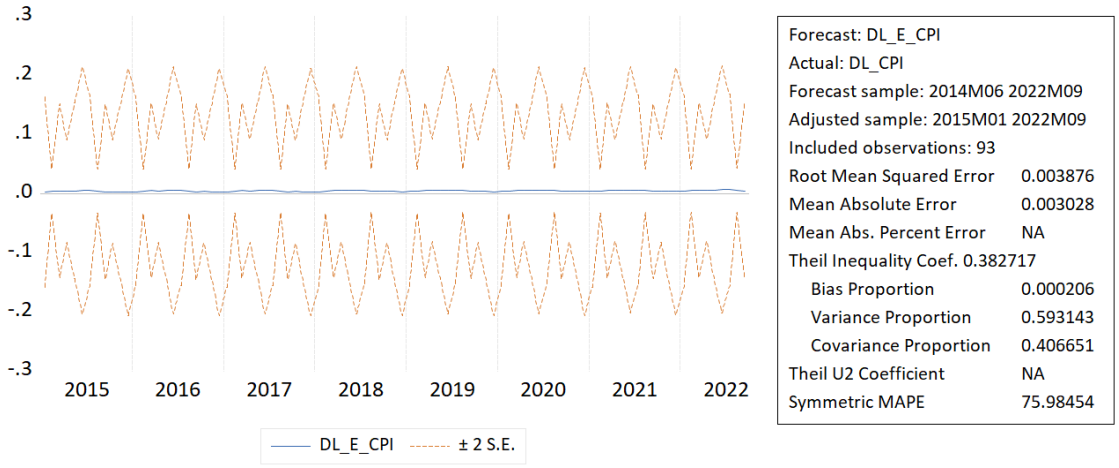

Table 10
ARIMA specification matric with significant coefficients

ARIMA model	**R^2**	**AIC**	**SC**	**HQC**
AR(1) MA(1)	0.185383	-8.31	-8.82	-8.27
AR(2) MA(1)	0.156464	-8.28	-8.17	-8.24
AR(1) MA(2)	0.171237	-8.30	-8.19	-8.26
AR(6) MA(6)*	0.303121	-8.35	-8.25	-8.31

*Chosen ARIMA model