THE DETERMINANTS AND PREDICTABILITY OF SOUTH AFRICAN LISTED PROPERTY RETURNS

by

Anil Ramjee

The Department of Construction Economics Management

Faculty of Engineering and the Built Environment at the University of Cape Town

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Supervisor: Kathleen Evans

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Abstract

This study investigates the determinants and predictability of listed property returns in South Africa based on the framework developed by Eugene Fama and Kenneth French. The study tests four asset pricing models, including the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964) and Lintner (1965), the Fama and French (1993) 3-Factor model, a model which adds the South African Bond Index to the CAPM and finally a model which includes macroeconomic, market and firm specific factors.

The empirical analysis makes use of macro-economic data and returns data of various portfolios of South African listed property stocks created based on a ranking of specific style factors. The style variables are size, momentum, liquidity, dividend yield, price to NAV, earnings yield, dividend growth, average cost of debt, loan to value ratio and the interest coverage ratio. The data was extracted from INET and the Muller and Ward (2015) data base which was subsequently updated by Shapiro (2016). The data sample extends over a 20-year period from January 1996 to December 2015. Ordinary least squares regression is used to determine the appropriateness of each of the four models. Furthermore, because these relationships change over time, a 5-year rolling regression analysis is used to understand the relationships over time.

The results suggest that the Capital Asset Pricing Model, the Fama and French (1993) 3-Factor model and the CAPM plus Bond Factor model do not fully explain the patterns of expected return of the South African Listed Property Index. However, the All Factor model is able to fully capture the pattern of expected return of the South African Listed Property Index. Furthermore, the results suggest that the South African listed property sector is less volatile and therefore relatively less risky than the overall stock market. Furthermore, the evidence suggests that that listed property behaves more like bonds than equity over the sample period. The research provides empirical evidence of a positive relationship between South African listed property returns and size, dividend yield and momentum is found. In addition, it is found that South African listed property returns are negatively related to the price to net asset value ratio. This suggests that South African listed property tends to revert to a long term mean net asset value.

The analysis of the performance of active trading strategies shows that once transactions costs are included none of the strategies are able to outperform a passive investment strategy. In addition, the study finds that there is no statistically significant difference between active and passive returns. Therefore, it is concluded that the South African listed property sector is efficient and profitable arbitrage opportunities should not exist.

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Abbreviations

ADF	Augmented Dickey-Fuller
ALBI	JSE All Bond Index
ALSI	JSE All Share Index
AMEX	American Stock Exchange
APT	Arbitrage Pricing Theory
bps	Basis Points
CAGR	Compound Annual Growth Rate
CAPM	Capital Asset Pricing Model
Cap	Capitalisation
CGT	Capital Gains Tax
CML	Capital Market Line
CPI	Consumer Price Index
EBITDA	Earnings before interest, taxes, depreciation and amortization
EMH	Efficient Market Hypothesis
EPS	Earnings per share
GDP	Gross Domestic Product
GFC	Global Financial Crises
GMM	Generalized method of moments
HML	High Minus Low
IFRS	International Financial Reporting Standards
JSE	Johannesburg Stock Exchange
LTV	Loan to Value Ratio
MAE	Mean Absolute Error
ME	Mean Error
NAREIT	National Association of Real Estate Investment Trusts

NAV	Net Asset Value
NYSE	Ney York Stock Exchange
OLS	Ordinary Least Squares regression
PLS	Property Loan Stock
PUT	Property Unit Trust
REIT	Real estate investment trust
RMSE	Root Mean Squared Error
SA	South Africa
S&P	Standard & Poor's
SARB	South African Reserve Bank
SAPY	South African Listed Property Index
SMB	Small Minus Big
SML	Security Market Line
SOE	State Owned Enterprises
TSE	Tokyo Stock Exchange
VAR	Vector Autoregressive
VIF	variance-inflating factor
WGBI	Citibank World Government Bond Index

Chapter 1: Introduction to the Research

1.1 Introduction

Predictability of returns has been the focus of a significant amount of financial research since the development of the Capital Asset Pricing Model (CAPM) in the 1960's (Cheng and Roulac, 2007). The predictability of asset returns has implications for both investors and academics. For investors, the predictability of asset returns could affect asset allocation and hedging decisions. On the other hand, academics are more interested in the understanding and implications for the theory of market efficiency (Ling *et al.*, 2000).

The Efficient Market Hypothesis (EMH) suggests that prices adjust instantly to fully reflect new information (past, public and private). This is the strong form of market efficiency and implies that asset returns are impossible to predict. The semi-strong form of efficiency claims that one could not forecast future returns using public information or past trends. Therefore, information such as SENS announcements, press releases and annual reports cannot be used to secure higher than normal returns. The weak form of efficiency suggests that asset prices reflect all past information such as historical prices and volumes (Malkiel and Fama, 1970).

According to Ling *et al.* (2000) most financial practitioners and economists regard the strong form of market efficiency as overly restrictive. Many academics direct their criticism to the assumptions of the EMH. Amongst others the EMH assumes that market participants are objective and make rational decisions that maximise utility. However, behavioural finance suggests that investors are in most cases subjective, prone to herd behaviour and have irrational expectations (Malkiel, 2003; 2005).

One of the main assumptions of the CAPM and the EMH is that markets operate efficiently. Cheng and Roulac (2007) point out that if markets were not perfectly efficient it may be possible to forecast asset returns using non-risk factors. Furthermore, Ling *et al.* (2000) argue that advances in asset pricing theory coupled with exponentially growing computing power have provided evidence that it is possible to forecast asset prices.

The CAPM was developed independently by Sharpe (1964) and Lintner (1965) using work done by Markowitz (1952) on diversification and modern portfolio theory as a foundation. The CAPM describes the relationship between an assets risk and expected return. The model considers the assets non-diversifiable risk (systematic, market risk) and the overall market return to calculate the assets expected return. The CAPM has been accepted academically, however research efforts to prove its validity in the practical sense has produced contradicting results (Cheng and Roulac, 2007). This led to the development of the Arbitrage Pricing Theory (APT) by Stephen A. Ross in the 1970's (Chen *et al.*, 1986). The APT is based on the theory that there are various investment factors that influence a securities return. These factors include macroeconomic, market and firm specific factors. Fama and French (1993) develop the Fama and French 3-Factor Model which uses market risk (CAPM Beta), a company's size and book to market value as independent variables in a multifactor equation. They find that smaller companies and companies with higher book to market ratios (also called value companies) generally outperform larger companies and companies with lower book to market ratios (also called growth companies). These theories are the building blocks to what is known as factor investing. Factor investing recognises that there are various quantifiable factors that influence a securities total return (Stone *et al.*, 2014).

The purpose of this research is to determine which macroeconomic, market and firm specific factors capture the sensitivity of South African listed property returns. Thereafter, the research evaluates whether an active trading strategy based on the predictability of returns can generate greater returns than a passive strategy.

1.2 Background to the Study

The South African listed property sector has experienced tremendous growth in the past 14 years. The South African Listed Property Index is an index which comprises of the top 20 most liquid listed property stocks, which have their primary listing on the Johannesburg Stock Exchange (JSE). The market capitalisation of the South African Listed Property Index (SAPY) has grown from R10.1 billion in March 2002 to R360 billion in July 2016. This is equivalent to growth of 3445% and a compound annual growth rate of 28%.

In the past, the South African listed property sector was divided into two categories, Property Unit Trusts (PUT) and Property Loan Stocks (PLS). These structures differed in terms of regulation, legal form and tax (Evans, 2009). PUTs were required to distribute 100% of net income and were restricted in their use of debt. A PLS unit consisted of a debenture portion (majority) and equity portion. Even though the PLS had no restrictions with respect to distribution payments, it would pay most of its net income as interest on the debenture portion of the unit. International listed property investors overlooked South African listed property because of the complex structure of both these entities (Vogelman, 2012).

According to SA REIT Association (2013 (b)) a real estate investment trust (REIT) is a structure that owns and in most cases also manages income producing property. Furthermore, the SA REIT Association (2013 (b)) explains that the REIT structure allows for a flow through of income after operating expenses and interest on a pre-tax basis to the owners of the REIT. The Johannesburg Stock Exchange approved the REIT structure at the end of March 2013 and has brought the real estate sector in South Africa in line with international standards and best practices. To date all the South African listed entities which intended to convert to the REIT structure have converted (SA REIT Association, 2013 (a)). Globally, the REIT structure is considered as the most efficient real estate operating model. According to Ntuli and Akinsomi (2016) South Africa has the tenth largest REIT market by capitalisation in the world. SA REIT Association (2017) show that as at the end of July 2017 the South African REIT market was worth R400 billion or (USD 30.3 billion using the July 2017 month end exchange rate of R13.19/USD). The USA has the largest REIT market worth USD 1.125 trillion, consisting of 228 REITs (FTSE NAREIT All REITs Index). The second and third largest REIT markets are the Australian (S&P/ASX 300 A-REIT Index) and Japanese (Tokyo Stock Exchange REIT Index) REIT markets worth USD 109 billion and USD 105 billion, respectively (Bloomberg, 2017).

Asset allocation is defined as an investment strategy that divides an investor’s wealth among different asset classes such as equity, bonds, property and cash. This diversification among different asset classes helps to reduce diversifiable or unsystematic risk and may help to improve the risk and return characteristics of a portfolio. Diversification happens when the assets that are included into the portfolio are less than perfectly correlated (Lausberg, 2014). Bhuyan *et al.* (2014) and Bradfield *et al.* (2015) find that the correlation between REITs and equity is relatively low and therefore may assist investors to optimise the risk and return characteristics of their portfolios. In addition, they mention that REITs are attractive due to their consistent dividend payments which improves the liquidity of their portfolios.

Using US data from 2001 to 2004, Hyde and Valero (2005) showed that the inclusion of REITs into a diversified portfolio improved returns by between 50 and 60 basis points annually. Furthermore, these portfolios had the highest return and the lowest risk compared to portfolios that did not include REITs. Olaleye (2011) examines the performance of different asset classes available in South Africa to determine if listed property is able to add diversification benefits to a mixed asset portfolio. The author used yearly total return data for the South African Listed Property Index, the All Share Index and the All Bond Index from 1999 to 2009 in the analyses. The evidence suggest that returns were enhanced when listed property was included in the portfolio, however risk was only reduced marginally. Significant risk reduction was found only when listed property replaced general equity in the portfolio. Ntuli and Akinsomi (2016) analyse monthly returns data for South African bonds, general equity, REITs and listed property from May 2013 to December 2015. The authors find that the expected return of a portfolio consisting of general equity, bonds and REITs is 0.88% which is superior to 0.79% expected return of a portfolio consisting of general equity and bonds only.

In South Africa, Regulation 28 of the Pension Funds Act was implemented to limit investments by pension funds to protect investors from imprudent asset allocation decisions of pension fund managers. Regulation 28 prescribes a maximum exposure of 75% invested in local equities, 25% in local property (maximum 15% in direct property) and 25% in foreign assets. It is common practice in South Africa to allocate approximately five per cent of the portfolio to listed property (Bradfield *et al.*, 2015). However, due to the significant outperformance of South African listed property in the past many funds are increasing their exposure over the five per cent allocation. Furthermore, Bradfield *et al.* (2015) find that the optimal allocation to listed property should be approximately 23% of the portfolio.

Listed property returns can be affected by various macro-economic and firm specific characteristics. Macro-economic variables such as interest rates, growth in gross domestic product (GDP), and inflation affect the overall demand and supply of property (Chen *et al.*, 1986). In addition, returns may be affected by firm specific factors such as sector concentration, dividend yields, earnings yields, dividend growth, vacancy rates, debt, size (market capitalisation), book to market value, past equity prices (momentum), and liquidity (Fama and French, 1992; 1993).

Listed property in South Africa is becoming more appealing as an asset class for both private and institutional investors, especially due to the REIT legislation. Most research identified focuses on the determinants and predictability of REIT returns listed in the US. This study intends bridging this gap in the research by concentrating our study on listed property in South Africa.

1.3 Problem Statement

The problem to be examined in this study may be stated as:

Information regarding the determinants and predictability of South African listed property returns could guide investors asset allocation and hedging decisions to reduce risk and improve returns. Furthermore, by determining which factors could influence South African listed property returns, one could develop an active trading strategy capable of earning greater than market returns. To date, research on the determinants and predictability of South African listed property returns has not been undertaken or published.

1.4 Research Questions

The research questions to be addressed may be stated as:

a) What macro-economic, market and firm specific factors can consistently explain the return characteristics of South African listed property?
b) Could an active trading strategy based on the predictability of returns generate greater than market returns?

1.5 Research Aim

The intended aim of this research is to:

Determine what factors influence South African listed property returns and if these returns can be consistently forecasted and used to develop an active trading strategy capable of outperforming the market.

1.6 Research Objectives

The research objectives to be achieved are to:

a) Analyse the impact of a wide range of macro-economic, market and firm specific factors on listed property returns in South Africa.
b) Develop a multifactor model to forecast listed property returns in South Africa.
c) Develop an active trading strategy that would outperform a passive buy and hold strategy and therefore earn greater than market returns.

1.7 Research Hypothesis

The main research hypothesis to be tested in this study is as follows:

H_0: Asset pricing models such as the Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory and variations of these models **can** fully explain the pattern of expected returns of the South African Listed Property Index (SAPY). Furthermore, an active trading strategy developed using factors found to have a relationship with expected returns of the South African Listed Property Index **can** outperform a passive investment strategy.

H_1: Asset pricing models such as the Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory and variations of these models **do not** fully explain the pattern of expected returns of the South African Listed Property Index (SAPY). Furthermore, an active trading strategy developed using factors found to have a relationship with expected returns of the South African Listed Property Index **cannot** outperform a passive investment strategy.

The main hypothesis is broken down into sub-hypotheses as listed below:

Hypothesis 1

Using the CAPM we test the following hypotheses:

Hypothesis 1.1

H_0: The CAPM fully explains the pattern of expected returns of the South African Listed Property Index (SAPY).

H_1: The CAPM does not fully explain the pattern of expected return of the SAPY.

Hypothesis 1.2

H_0: There is no statistically significant relationship between the market factor and the expected return of the SAPY Index.

H_1: There is a statistically significant relationship between the market factor and the expected return of the SAPY Index.

Hypothesis 2

Using the Fama and French 3-Factor model we test the following hypotheses:

Hypothesis 2.1

H_0: The Fama and French 3-Factor model fully explains the pattern of expected returns of the SAPY.

H_1: The Fama and French 3-Factor model does not fully explain the pattern of expected returns of the SAPY.

Hypothesis 2.2

H_0: There is no statistically significant relationship between the market, size and NAV factors and the expected return of the SAPY Index.

H_1: There is a statistically significant relationship between the market, size and NAV factors and the expected return of the SAPY Index.

Hypothesis 3

Using the CAPM plus Bond Factor model we test the following hypotheses:

Hypothesis 3.1

H_0: The CAPM plus Bond Factor model fully explains the pattern of expected returns of the SAPY.

H_1: The CAPM plus Bond Factor model does not fully explain the pattern of expected returns of the SAPY.

Hypothesis 3.2

H_0: There is no statistically significant relationship between the market and bond factors and the expected return of the SAPY Index.

H_1: There is a statistically significant relationship between the market and bond factors and the expected return of the SAPY Index.

Hypothesis 4

Using the All Factor model we test the following hypotheses:

Hypothesis 4.1

H_0: The All Factor model fully explains the pattern of expected returns of the SAPY.

H_1: The All Factor model does not fully explain the pattern of expected returns of the SAPY.

Hypothesis 4.2

H_0: There is no statistically significant relationship between the market, bond, momentum, size, liquidity, dividend yield, NAV, earnings yield, dividend growth, cost of debt, value and interest coverage factors as well as the inflation rate, prime interest rate and gross domestic product and the expected return of the SAPY Index.

H_1: There is a statistically significant relationship between the market, bond, momentum, size, liquidity, dividend yield, NAV, earnings yield, dividend growth, cost of debt, value and interest coverage factors as well as the inflation rate, prime interest rate and gross domestic product and the expected return of the SAPY Index.

Hypothesis 5

H_0: Returns from an active trading strategy are not different from a passive buy and hold strategy for South African listed property.

H_1: Returns from an active trading strategy are different from a passive buy and hold strategy for South African listed property.

1.8 Research Method

The above objectives will be achieved by adopting the following research method:

A literature review of the theoretical foundations of asset pricing will be conducted, followed by an investigation of the determinants and predictability of South African listed property returns.

The study will adopt a quantitative method to address the research problem. To achieve the research objectives a statistical analysis will be carried out on a set of secondary numerical data. The regression analysis will use the South African Listed Property Index (SAPY) excess return and various portfolio return data. These portfolios are generated using a style engine developed by Muller and Ward (2015) which creates equally weighted portfolios based on the ranking of the stocks for a specific style variable. The results of our regression analysis will determine the strength and statistical significance of various relationships. Using the results from the regression analysis, the study aims to development an active trading strategy and test whether the active strategy is capable of outperforming a passive buy and hold strategy. Lastly, the research findings and conclusions are presented followed by suggestions of further research.

1.8.1 Sources of Data

The research methodology will use the following sources of data:

a) Primary sources of data

   None

b) Secondary sources of data

   - Literature review of various academic journals, books and media articles.
   - The All Share Index (ALSI) and All Bond Index (ALBI) data was extracted from INET.
   - The South African Listed Property Index (SAPY) post March 2002 was extracted from INET. Pre March 2002 the SAPY index did not exist so a listed property index created by Bradfield *et al.* (2015) from January 1996 to February 2002 was used.
   - Returns data for various listed property portfolios created by a “style engine” was obtained from the Muller and Ward (2015) database.

1.9 Limitations

This study is subject to the following limitations:

a) The listed property sector in South Africa is very "young" and many companies have only been listed for a short period of time. Furthermore, the listed property sector is relatively illiquid. Therefore, only a limited number of stocks were used to create the listed property portfolios used in the analysis.
b) There could be possible structural breaks in the data because of the creation of the SAPY Index in March 2002 and the introduction of REITs in 2013.
c) This study will not take into account transaction costs of trading and therefore the return projections of the trading strategy will be overstated.

1.10 Structure of the Report

The research report will be structured as follow:

Chapter 1 provides an introduction and background to the study. In addition, the problem statement, research questions, and the research proposition are established. The research objectives and aim of the study are stated. The chapter introduces the research hypothesis which is followed by a short description of the research methodology and sources of data.

Chapter 2 provides a background to the study. The chapter provides the reader with a history of the South African listed property sector and its evolution from the property loan stock and property unit trust structures to the real estate investment trust structure. It analyses the performance, geographical diversification/changes and the risk profile of the South African Listed Property Index. Furthermore, the chapter reviews research on how and why listed property can have diversification benefits to an investment portfolio.

Chapter 3 provides a review of literature on the topic. The chapter begins by reviewing the Efficient Market Hypothesis (EMH), Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) which form the foundation on which the study is built. In addition, the chapter presents a discussion of various macro-economic, market and firm specific factors that have a theoretical or statistical relationship with listed property returns.

Chapter 4 describes the methodology and data to be used in the study. The chapter begins by explaining our chosen methodology and the main differences between quantitative and qualitative methods. The style engine used to create portfolios based on specific style variables or factors is described in detail. The models employed and various ways of assessing performance is explained. This is followed by an explanation of hypothesis testing and description of the hypotheses tested in this study.

In **Chapter 5**, descriptive statistics and correlation matrices are presented and the robustness of the data is tested. Thereafter, the simple regression and rolling regression results of each model are analysed. Lastly, the performance of an active trading strategy is compared to a passive buy and hold investment strategy.

Finally, **Chapter 6** concludes the study. Firstly, the results of the hypothesis tests are listed. The chapter then summarises the main findings and conclusions of the study which is followed by a description of how the objectives of the study were achieved. Lastly, suggestions for further research on the topic are presented followed by a full list of references.

Chapter 2: Background to the Study

In trying to forecast the performance of the SA listed property sector, one needs to understand the characteristics of the sector. The primary purpose of this chapter is to discuss the most important characteristics and changes in the South African listed property sector. Firstly, the chapter lists the benefits of investing in listed property and the advantages over direct property investments. Thereafter, the chapter discusses the legislative change from the Property Unit Trust and Property Loan stock structures to the globally recognised Real Estate Investment Trust structure. This is followed by a discussion on the evolution of the South African Listed Property Index as well the performance, risk and return characteristics of the index. Lastly, the benefits of having listed property in a balanced investment portfolio are discussed.

2.1 Benefits of Listed Property Investments

Property is a physical asset and its value is based on fundamentals such as location, quality, cost of construction and the cash flow it produces via contractual lease agreements (Pagourtzi *et al.*, 2003). Historically, property investors focused on the ownership of physical property also called direct property investments, however these investments are very expensive, illiquid and have high concentration risk (Doppegieter and Rode, 2002). A listed property fund is essentially an entity that owns and sometimes operates or develops income producing real estate and its shares are publicly listed on a stock exchange. It is a financial asset rather than a physical investment (Doppegieter and Rode, 2002). By acquiring a share in the company an investor has indirect ownership in a physical property or portfolio of properties owned by the fund. Baum (2009) lists the benefits of investing in listed property as follows:

- A listed property fund generally owns a portfolio of properties which reduces concentration risk to a single asset.
- Sometimes properties are located in different areas which provides geographical diversification.

- Listed property companies can own properties in different sectors of the market (e.g. office, retail, industrial or residential) which provides sector diversification.
- Real estate owned by REITs are managed by focused, performance driven professional management teams who are able to extract the most value from the underlying assets.
- The properties are operated by professional property practitioners which removes the inconvenience of property management (screening tenants, collecting rentals and maintaining the property).
- Buying direct property requires a relatively large amount of capital compared to buying shares of a listed company.
- Due to the strict reporting standards of the JSE, listed property companies provide the benefit of transparency.
- Listed shares have a high degree of liquidity as shares can be easily bought or sold with low transaction costs compared to the high transaction costs of direct property investments such as conveyancing (attorney) fees and transfer duties. In addition, there is no securities transfer tax (STT) charged when acquiring REIT shares.

In essence the listed property firms place the ownership of indirect property on the same level as ownership of direct property without the high transactions costs, waiting period and inconvenience of property management (SA REIT Association, 2013 (a)).

2.2 Real Estate Investment Trust (REIT) Legislation

In the past South Africa had two forms of property investment vehicles namely the property unit trust (PUT) and the property loan stock (PLS). Both entities differed in terms of regulation, legal form and tax. During 2013 the real estate investment trust (REIT) structure, which is an internationally recognized standard for property investment was introduced in South Africa.

SA REIT Association (2013 (b)) explains that a REIT is an investment vehicle that owns and often manager’s income producing real estate. The REIT structure is a tax regime which allows for a flow through of net property income to the shareholders on a pre-tax basis. Assuming a REIT distributes 100% of its net income to its investors, it would pay no corporate tax. Furthermore, a

REIT is exempt from Capital Gains Tax (CGT) from sale of direct or indirect investment property. The REIT structure continues to lead the way to a more globalized property investment sector (SA REIT Association, 2013 (a)).

On 25 October 2012, a formal REIT legislation was announced and published in the Taxation Laws Amendment Bill [B 34—2012] and on the 28 March 2013, the JSE published listing requirements that entities needed to comply with in order to qualify as a REIT.

The criteria are as follows (SA REIT Association, 2013 (a)):

- Minimum property holding of R300m.
- Minimum of 75% of gross income must be derived from “rental income”, this includes rental earned from shareholdings in listed property entities.
- Gearing is limited to 60% of gross asset value.
- At least 75% of its taxable distributable income must be paid to investors.
- The entity must have a risk committee to monitor risk and cannot enter into any derivative transactions that are not in the normal course of business.

2.3 The Tax Effect of the REIT Legislation on Investors

The dividend withholding tax provisions of the Income Tax Act and section 25BB of the Income Tax Act explain that distributions earned from REITs will be taxed as follows (Growthpoint, 2015):

Distributions received by resident shareholders have been put into a new category called taxable dividends. These distributions are exempt from the 15% dividend withholding tax, however it now represents income in the hands of the shareholder and is taxed at the shareholders’ individual income tax rate. Since the nature of distributions will change from interest income to rental income, the interest exemption for resident investors will not be available anymore. Interest income up to R23,800 for investors younger than 65 and R34,500 for investors older than 65 is exempt from tax. This will no longer apply. Distributions received by non-resident shareholders do not fall into the taxable dividends category but are subject to dividend withholding tax of 20%.

2.4 Property Diversification within REITs

Chan *et al.* (2003) explain that having a diversified portfolio of properties will reduce risk. Different property types have different cycles and by owning a diversified portfolio of assets a firm can diversify its tenant base and maintain a steady cash flow in different market conditions. However, an investor can create his/her own diversified portfolio by purchasing different REIT stocks that specialize in a certain property type and/or location. They add that since investors can reduce risk by diversifying their portfolios on a personal level there needs to be an incentive beyond risk reduction before the property diversification strategy adds value.

Block (2011) argues that sector and geographic diversification is not as important as in the past. He says that local market and microeconomic knowledge is essential in running a successful property business. In addition, expert knowledge of a specific type of property type provides management with an advantage over their more diversified peers (information advantage). For example, specialized management teams are more likely to hear about deals or unusual opportunities (distress sales) in its respective sector or location. Furthermore, if the company has development capabilities it would most probably have relationships with local authorities to speed up the entitlements (zoning) process.

Empirical evidence suggests that firms that specialize in a certain property and/or location outperform their more diversified peers (Chan *et al.*, 2003). According to Chan *et al.* (2003) the advantages of property level specialization include:

1. More focused strategy and better understanding of specific market.
2. Less markets to analyse.
3. Allows both investors and managers to have a better understanding of the company.
4. Allows both investors and managers the advantage of not needing to be experts in various property sectors.
5. Reduction in management and/or operating costs.

Chan *et al.* (2003) explain that larger REITs may be forced into other geographies or sectors because of limited expansion opportunities in their current markets. Furthermore, if a firm decided to venture out it should keep majority of its assets in the geographies or sectors in which management are experts in. They strongly advise against distributing holdings evenly among different property types or locations and recommend some type of specialized strategy.

However, Chan *et al.* (2003) point out the disadvantages of specialization as follows:

1. Limited amount of risk reduction.
2. Limited property diversity.
3. Being more susceptible to sector and geographic market movements.
4. Possibility of less stable cash flow.

According to Hook (2015), historically diversification meant that a listed property company invested across the different sectors (retail, office, industrial, residential) as well as different nodes within South Africa. However, currently diversification includes investing in physical or listed property in various global markets. South African listed property now provides investors with more than 35% exposure (on a see through basis) to offshore property from little over 5% in 2011 (Jankelowitz *et al.*, 2016 (a)). This number increases to 46% taking into account property counters not included in the SAPY index such as Capital and Counties (CCO), Redefine International (RPL), Capital and Regional (CRP) and Intu Properties (ITU). Tilly and Jardine (2016) point out that three more offshore stocks were listed (secondary listing) on the JSE in 2015 namely, Capital and Regional, Schroders Real Estate and International Hotel Group. In addition, UK based retailer Hammerson PLC made its secondary listing on the JSE in September 2017.

The property portfolios of companies such as New Europe Property Investments (NEP), MAS Real Estate (MSP) and Rockcastle Global Real Estate (ROC) are 100% invested outside of South Africa. Furthermore, Hook (2015) points out that 12 of the 20 companies in the SAPY have some offshore exposure with the biggest currency exposure to the Euro. Growthpoint and Redefine have 25% (via Growthpoint Australia) and 16% (via Redefine International PLC) exposure to foreign markets, respectively (Hook, 2015).

2.5 South African Listed Property as an Investment

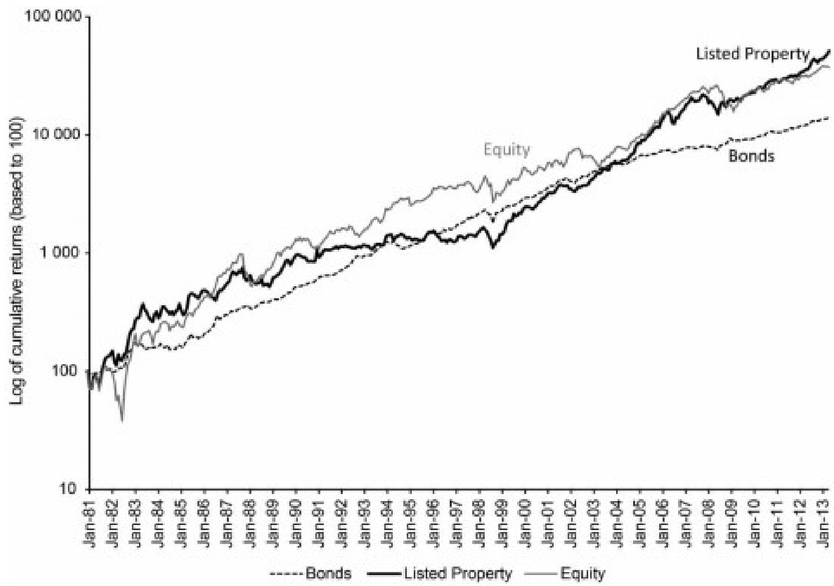
REITs offer low risk and recurring income distributions similar to bonds as well as the possibility of capital growth similar to general equities. SA REITs give an investor the opportunity to own some of the best commercial real estate in SA and sometimes globally (SA REIT Association, 2013 (a)).

Block (2011) assessed the performance of US listed REITs over a 35-year period ending December 2010. He found that REITs achieved a compound annual return of 14% compared to the S&P 500 and Dow Jones Industrial index which achieved returns of approximately 11.2% and 7.9%, respectively.

Using monthly US REIT data from January 1971 to December 1989, Liu and Mei (1992) find that REITs produced much higher excess returns relative to other sectors and bonds over the period. They find that the mean excess returns for REITs are 10bps, 46bps and 70bps more than small capitalisation stocks, large capitalisation stocks and bonds, respectively.

Bradfield *et al.* (2015) conducted similar research using data from February 1976 to April 2013 and found that South African listed property, general equity and bonds achieved annualized returns of 19.4%, 19.9% and 13.3% over the 37-year period, respectively (see figure 1). By taking a short time period Bezuidenhout *et al.* (2016) and Tilly and Jardine (2016) point out that the SA listed property sector has achieved annualized total returns of 17.5% over the 10 year period to the end of 2015. Furthermore, the listed sector has outperformed the general equities sector by 300bps annualized. For the calendar year 2015, Bezuidenhout *et al.* (2016) find that SA listed property achieved the highest total return amongst the traditional asset classes. SA listed property recorded a total return of 7.99% followed by SA cash and SA equities at 6.46% and 5.13%, respectively. SA bonds performed the worst recording a total return of -3.93%.

Figure 1: Cumulative returns (log scale) of listed property, bonds and equities (Jan 1981-Apr2013)



Source: Bradfield *et al.* (2015)

2.6 Evolution of the SAPY Index

Jankelowitz *et al.* (2016 (a)) analyse the evolution of the SAPY index over the 3-year period from January 2013 to December 2015. They find that only 12 out of the 32 counters have consistently remained in the index. Furthermore, actual overlap in stocks over the period is 53.6%, implying that just less than half the SAPY index has changed over the past three years. In addition, the SAPY index now includes property developers Pivotal Property Fund (PIV) and Attacq (ATT) which make up 6% of the index (Hook, 2015). These companies do not distribute earnings but instead reinvest these earnings into new developments and focus on driving capital growth in the share price.

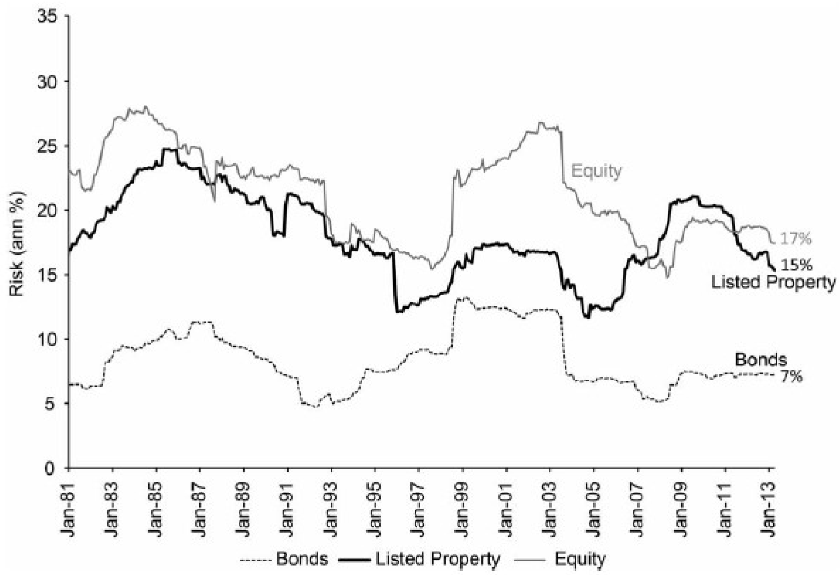
Jankelowitz *et al.* (2016 (a)) explain that comparing the SAPY yield to the SA government bond would be unsuitable because of the 35% exposure to offshore counters. They have compiled a weighted bond yield that is made up of various geographies that the SAPY has exposure to. From this calculation Jankelowitz *et al.* (2016 (b)) believe the true comparative bond yield is closer to 6.8% (as at January 2016). As at January 2016 they calculate the yield for the SA listed sector to be approximately 7.7%. Comparing this number to the SA 10-year government bond yield of 9.2% at the time makes property seem expensive at a 150bps premium. However, the SAPY dividend yield of 7.7% is neutral to slightly cheap (90bps discount) when compared to estimate of the comparable weighted bond yield of 6.8%.

2.7 Volatility of Listed Property

Volatility is a measure of risk and refers to the way a stock's price changes over time. Block (2011) argues that REITs in the US are less volatile than general equity. He further points out that the lower volatility of REIT stocks could be a consequence of the higher dividend yields of REIT stocks. The value of lower dividend yielding stocks is comprised of future earnings discounted to the present. In a scenario where the outlook for those earnings declines, even slightly, the stock price can fall quickly. However, the long-term nature of leases from which REITs derive earnings means that these companies have a more stable and predictable income which allows the REIT to continue paying dividends. Therefore the value should be less affected by short term changes in expectations (Block, 2011).

Liu and Mei (1992), Moyer (2008) and Bradfield *et al.* (2015) provide evidence that REIT returns are less risky compared to equities. Bradfield *et al.* (2015) show that this is also true for listed property in South Africa. Using the five-year rolling volatility from January 1981 to January 2013, they find that listed property has generally had a lower volatility (17.8%) than equities (21.1%) over the time period. As seen in figure 2 below the volatility of listed property was higher than stocks from the start of the global financial crises (GFC) in 2007 to approximately January 2011. Liu and Mei (1992) provide evidence that REITs have a lower average standard deviation compared to small and large capitalisation stocks and but a higher volatility compared to bonds. They find that REITs have the higher excess returns and lower risk compared to stocks which is in line with previous research.

Figure 2: Five-year rolling volatility of property, bonds and equities (Jan 1981-Apr2013)



Source: Bradfield *et al.* (2015)

Moyer (2008) found that listed property has a more stable return profile than equities. However, direct property demonstrated the most stable returns. Furthermore, to measure the trade-off between risk and return on a consistent basis she calculates the risk per unit of return for each asset class and provides evidence that listed property has a higher return per unit of risk compared to equities.

As explained earlier, REITs are required to pay at least 75% of its taxable distributable income to investors. As a result dividends make up a large proportion of the total return produced by REITs. Block (2011) points out that the high yielding characteristic of listed real estate provides the benefit of steady income even during bear markets which may reduce overselling during these times. Furthermore, the high cash flow pay-out ratio is an advantage to the shareholder as the shareholder has the choice in what to do with the dividend (i.e. reinvest, save or spend). However, owners of other types of securities must accept the decisions of the company's board of directors with respect to use of free cash flow (Block, 2011).

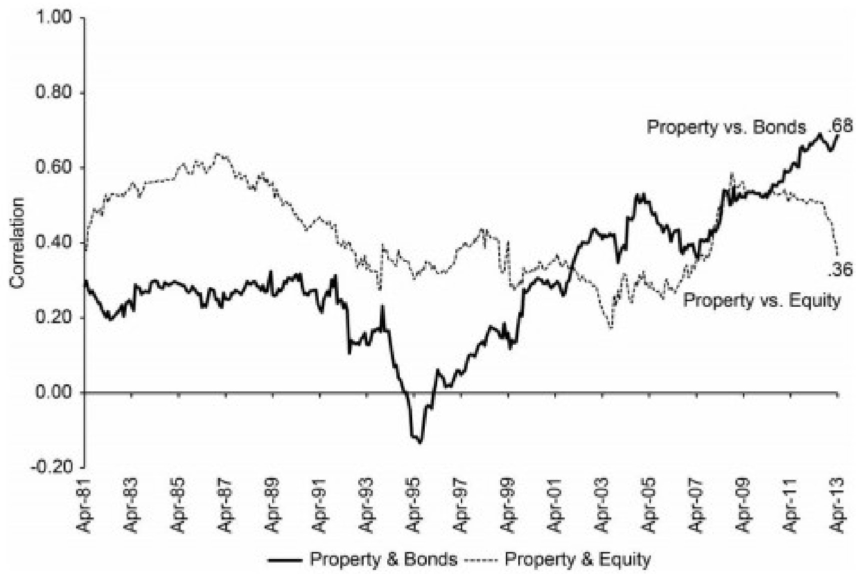
2.8 Diversification

Block (2011) argues that over the long term the key to consistent performance and capital preservation is diversification. The benefits of diversifying a portfolio of assets is to reduce risk without reducing returns and in some cases improving returns. He explains that correlation measures the price dependence one asset has on another asset. A correlation of +1 means that asset price movements will be perfectly matched and a correlation of -1 means that asset prices will move in opposite directions. A correlation of zero implies that's there is no relationship between the two assets. He adds that correlation is important when constructing a portfolio of assets. Diversification occurs when different assets are less than perfectly correlated with each other and results in a lower overall risk (Lausberg, 2014).

Using 20 years (from 1993 to 2013) of US data for various asset classes, Buller *et al.* (2013) calculate that equity REITs had a correlation of 0.56 with the overall equity market and a correlation of only 0.13 with investment grade bonds. Similarly, Liu and Mei (1992) analyse US REITs from January 1971 to December 1989 and find that equity REITS have a higher correlation with small cap stocks (0.80) compared to large caps (0.65) and bonds (0.18). This may be because REIT market capitalisations are approximately the same as small cap stocks.

Block (2011) investigates the correlation of the different asset classes in the US over the 35 year period and provides evidence which shows that US REITs returns have a 0.55% correlation with the S&P 500 returns. Ibbotson Associates (2001) analysis finds that the correlation between US REITs and other asset classes decreased significantly from the 1970s to the seven years between 1993 and 2000. The correlation between REITs and the S&P 500 fell from 0.64 to 0.25. The correlation between US REITs and the 20-year U.S. Government Bond declined from 0.27 to 0.16.

Figure 3: Five-year rolling correlations between property, bonds and equity (Jan 1981 – Apr 2013)



Source: Bradfield *et al.* (2015)

South African listed property behaved slightly differently over time. Between April 2010 and April 2013 the correlation between South African listed property and bonds was higher than the correlation between listed property and equity (Bradfield *et al.*, 2015). They argue that this is evidence that listed property behaved more in a bond-like manner than an equity-like manner over the period of time. This is in contrast to its behaviour prior to 2000 where the correlation between listed property and equity was significantly higher than the correlation between listed property and bonds (see figure 3 above).

2.9 Asset Allocation

The four main investment asset classes are equities, fixed income or bonds, cash and property. Asset allocation is a technique used to allocate portions of the total investment to different asset classes in order to achieve certain investment objectives. Most balanced funds have an allocation towards property either direct or indirect via listed funds. Internationally, balanced portfolios have between 3% and 4% allocated to real estate even though researchers have found evidence that the optimal allocation should be approximately 20% (Bradfield *et al.*, 2015). Buller *et al.*

(2013) say that active investment managers in the US have been underweight in equity REITs for the ten years leading up to 2013. In addition, they find that in 2012 US pension funds only allocated approximately 2.4% to REITs.

By using a hypothetical portfolio consisting of 40% bonds, 50% general equity and 10% T-Bills, Ibbotson Associates (2001) calculate the average annual return of the portfolio of 11.8% with risk of 11.2% (standard deviation). However, by allocating 20% of the fund to REITs, keeping T-Bills at 10% and reducing the percentage of bonds and general equity to 30% and 40%, respectively, the average annual return increased to 12.2% with a risk level of 10.8%. Thereby increasing returns by almost half a percent and reducing risk by a similar amount. On the contrary, Olaleye (2011) finds that the addition of South African listed property to a domestic mixed asset portfolio only marginally reduces risk, nonetheless, inclusion does significantly improve returns. Olaleye (2011) concludes that listed property does not offer as much diversification benefits as found in previous research.

In terms of overall asset allocation the situation in South Africa is not different from international allocations as Bradfield *et al.* (2015) find that South African fund managers limit their property exposure to five percent. However, using listed property data from February 1976 to 2013 they show that the optimal allocation to listed property is much higher at approximately 23%.

Buller *et al.* (2013) point out the main reasons why fund managers do not set high allocations to REITs:

- REITs are not well understood by diversified portfolio managers.
- Given its unique structure, investors find it difficult to value REITs.
- Investors are concerned with the relatively low liquidity of most REITs (most REITs fall into the small capitalisation space which is inherently illiquid).
- The lack of analyst coverage and research.
- The SA listed property sector is too small to achieve higher allocations (Mkhize and Bekwa, 2009)

2.10 Conclusion

Globally, the REIT structure is considered as the most efficient real estate operating model. The JSE approved the REIT structure at the end of March 2013 and has brought the real estate sector in South Africa in line with international standards and best practices.

Over the 10 year period to the end of 2015 the SA listed property sector has achieved annualized total returns of 17.5% outperforming the general equities sector by 300bps (Bezuidenhout *et al.*, 2016; Tilly and Jardine, 2016). This coupled with evidence from Liu and Mei (1992), Moyer (2008) and Bradfield *et al.* (2015) that REIT returns are less risky compared to equities provides evidence that REITs are essential in a balanced investment portfolio. Bradfield *et al.* (2015) find that South African fund managers limit their property exposure to five percent, an allocation similar to international fund managers. However, they show that the optimal allocation to listed property is much higher at approximately 23%. Buller *et al.* (2013) argue that fund managers do not set high allocations to REITs because REITs are considered small, illiquid and difficult to understand and analyse. As the SA listed property sector grows these obstacles will be removed and it will become easier for investors to justify increasing their listed property investment allocations.

The following chapter reviews literature on the topic starting with a review of the relevant theoretical concepts. In addition, it presents a discussion of various macro-economic, market and firm specific factors that have a theoretical or statistical relationship with listed property returns.

Chapter 3: Critical Literature Review

Chapter 3 critically reviews and analyses the theoretical concepts, methodologies and findings of literature related to the study. It initially focusses on theoretical concepts which form the foundation on which the study is built. The first concept analysed is the Efficient Market Hypothesis which helps to understand if prices always reflect the intrinsic value of the underlying asset or there is mispricing and arbitrage opportunities exist. This is followed by a discussion of the Capital Asset Pricing Model (CAPM) which is one of the fundamental concepts of investment theory. The CAPM simply shows the linear relationship between risk and return of an investment. Furthermore, because of the simplicity of assumptions and empirical failure of the CAPM the Arbitrage Pricing Theory (APT) was developed. The model is essentially a multivariate version of the CAPM that calculates the return of a stock based on macroeconomic, firm specific or market related factors. The following section reviews various macro-economic, market and firm specific factors which previous literature has found to have a theoretical or statistical relationship with listed property returns. Thereafter, the chapter reviews literature that studies the predictability of listed real estate returns and the possibility of generating superior returns using active trading strategies.

3.1 Efficient Market Hypothesis

Many researchers accredit the Efficient Market Hypothesis (EMH) to Eugene F. Fama in a paper entitled Efficient Capital Markets: A Review of Theory and Empirical Work, however the concept was discussed in research papers as far back as the 19th century. Malkiel and Fama (1970) explain that the primary role for capital markets is the efficient allocation of resources and prices should ideally provide signals for this allocation. Investors can choose to buy a stock which should represent a company's investment-production decision and the price of the stock is assumed to fully reflect all available information. Malkiel and Fama (1970) argue that a market in which prices fully adjust to reflect all information is considered to be efficient. Furthermore, Jensen (1978) states that a market is efficient with respect to information if it is impossible to make economic profits using trading strategies based on this information set. Timmermann and Granger (2004) point out that if prices were predictable, all investors would use it to produce unlimited wealth which cannot occur in a stable economy.

EMH is based on three market assumptions. Firstly, Malkiel and Fama (1970) assume that there are no trading or transaction costs (frictionless market). Timmermann and Granger (2004) explain that if transaction costs are high, predictability may be ruled out as the costs may outweigh the benefit. Secondly, all information is available to all participants at no cost and lastly all market participants agree on the implications of information on a stock's price. This implies that market participants do not ignore relevant information and this information is processed in a rational manner and systemic errors are prevented (Fama, 1991). However, all three of these assumptions are irrelevant in the real world and all are potential sources of market inefficiency. For example, market information is not free and market participants often make irrational decisions and sometimes base investment decisions on emotions such as fear and greed instead of objective valuations (Arnerich *et al.*, 2007). Jensen (1978) suggest that a less restrictive but more realistic thesis would be that prices reflect all information to a point where the marginal benefit (excess returns) of trading strategies that use information is greater than the marginal cost of obtaining that information.

Chan *et al.* (2003) explain that because different information is available for different stocks, the concept of market efficiency should rather be thought off as a matter of degree. Malkiel and Fama (1970) find empirical evidence on three information subsets of the hypothesis based on a set of variables contained in the information. The weak form of the EMH which asserts that security prices reflect all past price, returns and trading volume history only. Therefore, an investor cannot consistently earn future abnormal profits by using trading strategies based on historical prices. According to Malkiel and Fama (1970) this subset is the easiest to test and has the most evidence to support the thesis. Even though evidence supports the weak form of the EMH, some investors still use technical analysis to try and forecast the direction of a stock price using patterns of past price and volume data.

The second subset is called the semi-strong form of the EMH which suggests that current security prices reflects all publicly available information, that is, not only historical prices but other public information such as financial information (price-earnings ratios, cash flows and net asset values), news and SENS announcements. In this scenario both technical analysis and fundamental analysis would not allow investors to earn excess profits. Fundamental analysis is, including but not limited to, the analysis of a company's business risk, operations and financial metrics which is then used to make investment decisions. Haugen and Baker (1996) argue that fundamental investors do not believe that technical factors affect the returns of stock. They believe that risk premiums on expected stock returns are consistently changing relative to the risk of the stock or as investors sensitivity to overall risk varies. For example, in recessionary times, equities tend to become riskier, furthermore, the average investor has a lower net worth and therefore becomes less risky.

Researchers use the method of residual analysis to examine the effects of the public information. Evidence suggest that prices for stocks which earnings have outperformed the market increase to the time of announcement and vice versa. In addition, it is found that only between 10% and 15% of information in earnings announcements has not been anticipated by the market (Malkiel and Fama, 1970). Malkiel and Fama (1970) conclude that the available evidence largely supports the semi-strong form of the EMH.

The third and final subset is called the strong form of the EMH and suggests that the current price of a stock rapidly reflects all information (public and private). In other words an investor cannot earn economic profits by trading on monopolistic non-public information that the investor may have, called insider information (Malkiel and Fama, 1970). They find evidence that this model is not strictly valid. This is the only subset which lacks strong empirical evidence since insider trading is illegal.

3.1.1 Active versus Passive Investing

Benjamin Graham, who is considered the father of fundamental investment analysis explains the difference between price and value – "Price is what you pay; value is what you get". Arnerich *et* *al.* (2007) define active investment management as an investment method that uses qualitative and quantitative research combined with experience and market knowledge to choose stocks with the objective of outperforming a particular market represented by an index. Active investment managers generally search for undervalued stocks (current price is less than intrinsic value) which they would buy and overvalued stocks which they would sell (current price is more than intrinsic value). Passively managed investments attempt to replicate a portfolio of stocks in a certain market index and no active positions are taken. Furthermore, most indices are market capitalisation weighted and therefore put a higher weighting on the largest companies, potentially having greater exposure to stocks which have a higher probability of falling (Arnerich *et al.*, 2007). According to them, active management is most valuable in sectors which are considered to be less efficient and there are more potential mispricing opportunities.

Chan *et al.* (2003) suggest two possible reasons the REIT market is less efficient than the general equity market. Firstly, historically the REIT sector consist mainly of small capitalisation stocks and therefore were not the focus of large institutional investors. Thus, the stocks were not well covered by analysts and the market would find it difficult to evaluate the intrinsic value of the stock. This allowed investors to potentially earn above average profits if they made the effort to find the true value of the stock. Secondly, it is difficult to determine the true value of the properties which REITs own. These properties are usually located in various geographical areas with its own microeconomic information which is difficult for investors to obtain. Analysts who conduct such research will be unwilling to disseminate this information for free. The SA listed property sector is young and less efficient than the other sectors.

Burton G. Malkiel has been a strong advocate of the EMH for the past 40 years. He argues that markets prices adjust instantly to new information and therefore no arbitrage opportunities exist that would allow an investor to constantly earn economic profits without taking on higher risk (Malkiel, 2005). He suggests that a “blindfolded chimpanzee throwing darts at the stock pages could select a portfolio that would do as well as the experts” (Malkiel, 2005:2). Basically, what he is implying is that an investor should abandon active portfolio management or stock picking and rather invest in passive strategies which buys and hold all the shares in a specific index. Using mutual fund performance data Malkiel (2005) found evidence that actively managed funds do not beat the relevant index on an after fee basis over the long term. He finds that active managers underperform an S&P 500 index fund by approximately 2.52% and 2.24% (annualized) over a 10-year and 20-year investment horizon, respectively. Similarly, he finds that in the short term (one to two years) only 20% of active managers are able to outperform the relevant index. He believes that investing is a zero-sum game in which investors who underperform are balanced by investors who outperform. Taking this into account the large proportion of underperformance is directly due to expenses. Malkiel (2005) finds that the expense ratio for mutual funds is slightly below 1.5% compared indexed funds which have expense ratios of less than 0.2%. Furthermore, active investors incur higher trading/transaction costs compared to passive funds.

Ling *et al.* (2000) examine the predictability of excess REIT returns relative to the returns of the general stock market, small capitalisation stocks and risk-free government T-Bills. They use US data from 1980 to 1996 and find evidence that an active trading strategy, including transaction costs, involving the three asset classes does not provide excess return compared to a buy and hold strategy. Interestingly, they find that a REIT buy and hold strategy outperforms a buy and hold strategy for the S&P 500, US T-Bills and the small capitalisation index. Furthermore, they find that the model is less robust in out-of-sample predictions compared to in-sample predictions.

Research conducted by Arnerich *et al.* (2007) on large and small capitalisation active and passive funds shows that active management provides investors with better downside protection than passive strategies. In bear market periods, active funds can be proactive and choose to invest in better performers or take more defensive positions (holding a higher proportion of cash). Furthermore, behavioural theory, more specifically the Prospect Theory suggests that the average investor is risk averse and values losses more than gains. Therefore, physiologically active strategies may be at an advantage (Arnerich *et al.*, 2007). Chan *et al.* (2003) suggest that the probability of an investor earning above average returns is higher if there is less information about the stock or there are fewer informed people trading in the stock.

Bharati and Gupta (1992) find empirical evidence that an active trading strategy outperforms the passive buy and hold strategy even when they took into account trading costs. Using US REIT return data from 1973 to 1990 they find that an active trading strategy that involves quarterly portfolio revisions outperforms a passive strategy. However, when the analysis is done using monthly revisions the outperformance is reduced due to large transaction costs.

3.2 Capital Asset Pricing Model (CAPM)

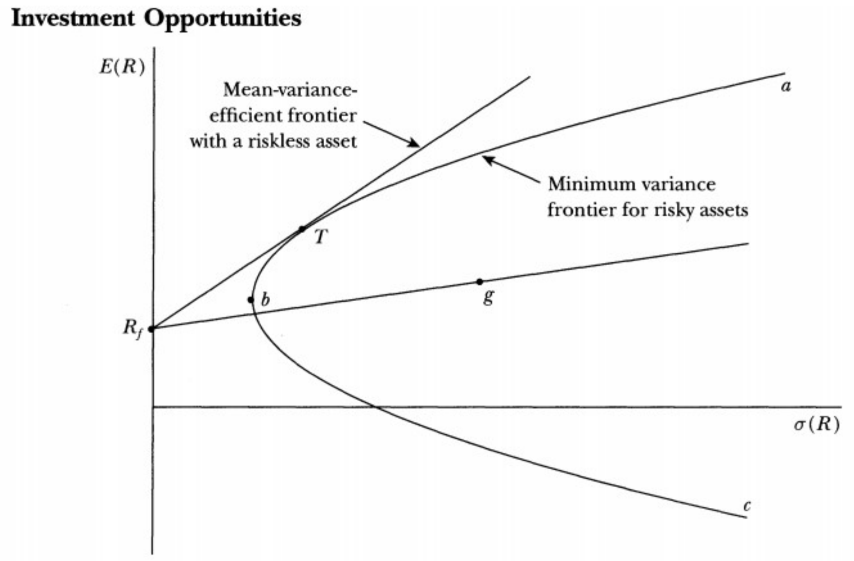
The Capital Asset Pricing Model (CAPM) was developed by Sharpe (1964) and Lintner (1965) based on research conducted by Markowitz (1952). The CAPM is a simple and intuitive model that describes the relationship between risk and expected return (Fama and French, 2004)

The CAPM is one of the fundamental concepts of investment theory and simply states that in a perfectly efficient market the differences in security returns are a function of the risk premium required by an investor for taking market risk and this market risk is the sole determinant of differences in expected return (Cheng and Roulac, 2007).

Markowitz (1952) explains that the portfolio selection process can be separated into two stages. In the first stage the investor uses experience and observation to establish a view of future performance of securities. In the second stage the investor chooses a portfolio based on the views from the first stage. In the model the investor is assumed to be risk averse and choses a portfolio that minimizes the variance and maximizes expected return. Therefore, it is called the mean-variance model (Fama and French, 2004).

Fama (1991) points out that Sharpe (1964) and Lintner (1965) add two assumptions to the Markowitz (1952) model to identify portfolios that are mean variance efficient. Firstly, they assume investors are in complete agreement regarding the probability of future returns and they assume that in any circumstance (value, risk profile and time period) all investors can borrow or lend money at the risk-free rate.

Figure 4: Efficient Frontier and the Capital Market Line



Source: Fama and French (2004)

Fama and French (2004) explain the model using the figure above. The vertical axis is the expected return of the different portfolios and the horizontal axis is the risk of the portfolios measured by the standard deviation of the expected return. The curve *abc* is called the minimum variance frontier and shows the portfolios which have the least risk at different levels of expected return. The efficient frontier also called the Markowitz frontier is the section of the minimum variance frontier that shows the portfolios with the highest expected return for a given amount of risk. Rational investors will not invest in portfolios that lie below the efficient frontier. The risk-free asset has a zero standard deviation and has a zero correlation with all the risky assets. Considering the possibility of risk-free lending and borrowing an investor can create a portfolio that includes both risky and risk-free assets. All these portfolios lie on the capital market line (CML) also called the mean-variance efficient frontier with a riskless asset. The portfolio which lies at the tangency point between the CML and the efficient frontier is called the market portfolio and is the most efficient risky portfolio (which consists of a market capitalisation weighted portfolio of all the risky assets – it is the best diversified portfolio) – it is the portfolio that is expected to produce the highest return with a given amount of risk. The CML traces portfolios which are made up of different proportions of only the risk-free asset and the market portfolio. An investor chooses a portfolio which lies on the CML depending on the investors risk tolerance. Choosing a portfolio on the CML which lies above the tangency point means that the investor is risk tolerant and is borrowing money at the risk-free rate to invest in the market portfolio. Similarly, portfolios which lie below the tangency point on the CML means that the investor is risk averse and is lending money at the risk-free rate and excepting a lower proportion of the market portfolio (Lausberg, 2014).

Lausberg (2014) argues that the total risk of an asset is made up of two parts. The unsystematic risk also called firm specific risk plus systematic risk which is also known as market risk. Market risk cannot be entirely diversified away; however, a part of firm specific risk can be eliminated by way of diversification. Beta measures the co-movements of an assets returns relative to the market portfolios return. It is the best measure of an assets risk, specifically market risk.

Fama and French (2004) and Lausberg (2014) define the beta coefficient as follows:

$$\beta_{im} = \frac{Cov\ (R_i, R_m)}{\sigma^2\ (R_m)} \tag{1}$$

Where,

β_{im} : Market Beta

$Cov\ (R_i, R_m)$: Covariance of the asset returns and market returns,

$\sigma^2\ (R_m)$: Variance of the market return

Lausberg (2014) and Silvestri (2016) explain that beta can be positive, negative or zero. A positive beta between 0 and 1 means that the security moves in the same direction as the market but with less volatility, examples of these stocks are listed property and utilities. A beta of greater than one implies that the returns of the asset are magnified by the movements of the market. Examples of such companies are ones that sell luxury goods or technology. If the beta is negative, one can expect the return of the asset to outperform when the market underperforms and vice versa. These assets can be used as hedges. Assets with a beta of zero have no relationship with the market and it is rare to a find a stock with a zero beta.

It follows that the excess returns of every portfolio will be linearly related to the market portfolio's excess returns (Silvestri, 2016). This relationship between an assets expected return and market beta is expressed by the Sharpe-Lintner CAPM as follows:

$$E(R_i) = R_f + \beta_i \left[E(R_m) - R_f\right)], i = 1, \ldots., N \qquad (2)$$

Where,

$E(R_i)$: Expected return of an asset

R_f : Risk-free rate

$E(R_m)$: Expected rate of return on market

β_i : Beta coefficient.

In other words, the expected return of an asset $E(R_i)$ is the risk-free rate R_f plus a risk premium. Where the risk premium is defined as the assets market β_i multiplied by the difference between the expected return on the market portfolio $E(R_m)$ and the risk-free rate.

Schweser (2009) explains that because the model assumes diversification is free, an investor will not be compensated for unsystematic risk. Therefore, the expected equilibrium return of an individual security will be determined by its market risk. Plotting the relationship between an individual security's market risk and return results in the security market line (SML). The SML is a graphical representation of the Sharpe-Lintner CAPM equation.

An investor could use the CAPM to identify mispriced securities by comparing the expected rate of return of the security to the required rate of return as calculated by the SML (Schweser, 2009). Furthermore, he explains that if the returns do not match, it suggests that the security is either over or under valued and an appropriate trading strategy can be formed. If the security lies above the SML, it is estimated to have a return higher than what is required by the SML and would be considered undervalued and should be bought. On the other hand, a stock which lies below the SML is estimated to have a lower return than required by the SML and would be considered overvalued and should be sold. Lastly, an asset that lies on the SML is correctly valued and an investor would be indifferent to buying or selling it.

Najand *et al.* (2006) analyse US equity REITs from June 1995 to December 2003 using GARCH (generalized autoregressive conditional heteroskedasticity) and GARCH-M models. They find an adjusted R^2 of 23%, which is evidence that the data does not fit the CAPM well. However, they find an annualised alpha of 2.25% which is significant at a 5% level, which means that REITs produced excess returns of 2.25% per annum over their sample period. Furthermore, they find a time varying beta of 0.24 significant at a 1% level suggesting that REITs have low market (systematic) risk.

On the contrary, Fama and French (1992; 2004) point out that the empirical record for the CAPM is poor. Fama and French (1992) use a sample of companies listed in the US from 1963 to 1990 and find that once they controlled for variables such as size, book to market value, earnings yield and leverage the stock market beta has no relationship with the cross section of average returns. Fama and French (2004) updated the Fama and French (1992) paper using data from 1923 to 2003 and similarly find no relationship between the stock market beta and returns. These results may be a consequence of the unrealistic assumptions (failure in the theory) or it may be that researchers find it difficult to conduct valid tests of the model. For example, the CAPM required the risk of a stock to be measured against the "market portfolio", however, in principle this portfolio could also include non-financial assets such as consumer durables, real estate and human capital. Furthermore, even if the model is only limited to financial assets, should one only use general equity or should bonds, REITs and cash be included (Fama and French, 2004). Furthermore, they argue that the efficiency of the market portfolio is based on (1) complete agreement (2) unrestricted borrowing and lending at the risk-free rate (3) zero transaction costs and (4) unrestricted short selling of risky assets, all of which are unrealistic assumptions.

The theory that stocks returns relied on one catch-all systemic factor appeared to be unrealistic and as a result researchers began adding more factors to test if they had any effect on stock returns (Silvestri, 2016). This led to the development of the Arbitrage Pricing Theory.

3.3 Arbitrage Pricing Theory (APT)

The empirical failure of the CAPM led to the development of the Arbitrage Pricing Theory (APT). Arbitrage is defined as taking advantage of a temporary difference between prices of the same asset (security mispricing) to earn risk-free profits (Silvestri, 2016). Silvestri (2016) argues that the main assumption of the CAPM was that markets are efficient which eliminates the potential for arbitrage and is the starting point of the APT. The APT was developed by Stephen A. Ross in the 1970’s with the aim of developing a less restrictive more intuitive model than the CAPM. The model is essentially a multivariate version of the CAPM that calculates the return of a stock based on macroeconomic, firm specific or market related factors.

Ross (1976) made the following assumptions:

- A multi-factor model can describe the relationship between risk and return of an asset.
- Firm specific or idiosyncratic risk can be eliminated through diversification.
- Markets do not allow for persistent arbitrage opportunities – if there is an arbitrage opportunity; an increase in demand of the security will lead to an adjustment in prices and the opportunity for risk-free profits will be eliminated.
- There are no transaction costs.
- There are no taxes.

According to Silvestri (2016) the differentiating, ground breaking aspect of the APT is that it does not make any assumptions about the investors preference and the distribution of returns. Thus, the APT became the foundation on which research on multifactor models was built. Furthermore, Roll and Ross (1980) point out two important differences between CAPM and APT. Firstly, the APT allows for more than one generating factor. Secondly, since a market at equilibrium implies that there are no arbitrage opportunities available, every equilibrium can be explained by a linear relationship between a security's expected return and its sensitivity to movements in a specific factor. These sensitivities are termed factor betas, response amplitudes or factor loadings.

A linear multi-factor model is written as follows (Roll and Ross, 1980):

$$R_i = E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \cdots + \beta_{ik}F_k + \epsilon_i \quad (3)$$

$$i = 1, \dots, n$$

Where,

R_i : Return of the *i*th asset

$E(R_i)$: Expected return of the *i*th asset

F_k : is the *k*th risk factor that influences an assets returns

β_{ik} : Beta coefficient which measures the sensitivity of the *i*th asset returns to the movements in the factor F_k . These are called factor betas, factor loadings or response amplitudes.

ϵ_i : is the risky asset's idiosyncratic component with mean zero, also called the noise term.

Ross (1976) builds on the multi-factor model to develop the Arbitrage Pricing Theory. He assumes that there are enough assets available to create a portfolio free of any firm specific or non-systematic risk leaving only the risk of the specific factor (i.e. the noise terms become negligible).

Taking into account the no arbitrage condition which states that all portfolios that are constructed (a) using no wealth and (b) having with no risk, must earn on average zero returns (Van Rensburg, 1997). This leads to the APT pricing formula as follows (Ross, 1976):

$$E(R_i) = R_f + \beta_{i,1}\lambda_1 + \beta_{i,2}\lambda_2 + \cdots + \beta_{i,k}\lambda_k \quad (4)$$

$$E(R_i) = R_f + \beta_{i,1}\left[E(R_1) - R_f\right] + \beta_{i,2}\left[E(R_2) - R_f\right] + \cdots + \beta_{i,k}\left[E(R_k) - R_f\right] \quad (5)$$

Where,

$E(R_i)$: Expected return of the *i*th asset

R_f : Rate of return of a riskless asset

β_i : Beta coefficient, factor loadings or response amplitudes

λ : Risk premium for each factor

Van Rensburg (1997) points out that the APT does not specify which factors are the most appropriate, however, he does provide some guidelines on the characteristics required of potential APT factors. He says that factors should represent unexpected movements in systematic or market risk. Furthermore, the data for the factor should be consistent and accurate. Lastly, the researcher should be able to justify the use of the factor on economic grounds. Researchers such as Chen *et al.* (1986) and Ferson and Korajczyk (1995) have studied the use of macroeconomic factors such as gross domestic product (GDP), interest rates, inflation, industrial production and money supply. Whereas other authors such as Chan *et al.* (1991) and Fama and French (1992; 1993) use firm specific factors such as size, earnings, cash flow yields and book to market values in their analysis.

Research conducted by Chen *et al.* (1986) and Ferson and Korajczyk (1995) find evidence that certain factors do influence the market; other than what is captured by the CAPM. Chen *et al.* (1986) analyse the impact of macroeconomic variables on US securities using data from January 1953 to November 1983. They find evidence that industrial production, changes in the risk premium (spread between government and corporate bonds), and tilts in the yield curve have a significant effect on the returns of securities listed on the New York Stock Exchange (NYSE). They find only a weak relationship (and only during periods of high volatility) between stock returns and unexpected and expected inflation. Furthermore, they find that real per capita consumption and an index of oil price changes has no effect on expected returns.

Ferson and Korajczyk (1995) test the long-term return forecasting ability of the APT using a beta pricing framework. They used monthly data of all stocks listed on the NYSE and the American Stock Exchange (AMEX) between 1962 and 1989. The generalized method of moments (GMM) was used to estimate their model which consisted of macroeconomic factors similar to those used by Chen *et al.* (1986). They find evidence that a large portion of the predictability of returns (from one month to two years) can be explained by their model. Their evidence suggests that single factor models and five-factor models can explain approximately 60% and 80% of the predictable variance in their samples.

Chan *et al.* (1991) investigate the relationship between returns on Japanese stocks and four firm specific variables namely, earnings yield, size, book to market ratio, and cash flow yield. They use monthly returns data of stocks listed on the Tokyo Stock Exchange (TSE) from January 1971 to December 1988 and group the stocks into portfolios based on rankings of each variable. Their analysis employs the Seemingly Unrelated Regression model to test for significance. Their empirical evidence suggests that the book to market ratio and the cash flow yields significantly affect expected returns.

Fama and French (1992) analyse the relationship between firm level returns and firm specific factors, namely, market beta, size, earnings price ratio, leverage and the book to market value which is defined as the ratio of book value of common equity to total market capitalisation. They analyse the relationship using a cross-sectional regression analysis of the average stock returns of non-financial US stocks listed on the NYSE, AMEX and the NASDAQ from 1963 to 1990. The reason for excluding financial stocks is that they operate at a higher leverage than the average stock. Their evidence suggests that there is no relationship between the market beta and the cross sectional of average returns. However, they find a negative relationship between size and returns and a positive relationship between book to market value and returns, even when the other variables are included.

Fama and French (1993) developed the Fama and French 3-Factor Model. Similarly to Fama and French (1992) the three stock related factors are overall equity (market beta), size and book to market (value). However, the authors extend the former paper by including U.S. government and corporate bonds to their analysis. Furthermore, they include factors that could affect the returns on bonds, namely the term premium and default premium. Lastly, they adopt a time series regression approach instead of the cross-sectional regression approach. The analysis is done using portfolios formed by ranking stocks based on each variable. The size factor (small minus big/SMB) is approximated by the difference between the average monthly return of three small portfolios minus the average return on three big portfolios. Similarly, the book to market factor (high minus low/HML) is approximated by the difference between average monthly return of two high book to market value portfolios minus the average return on two low book to market value portfolios. The reason they use this technique is to minimise the possible correlations between factors (Silvestri, 2016). The difference between the yields on long-term bonds and the one-month treasury bill is used as a proxy for the unexpected changes in interest rates. The default risk premium is calculated as the difference between the return on a portfolio of corporate bonds and the yield on a long-term government bond. Their analysis uses stocks listed on the NYSE, AMEX, and NASDAQ from 1963 to 1991. The evidence suggests that their three-factor model does a better job than the CAPM in explaining excess portfolio returns. They find evidence supporting the Fama and French (1992) findings that stocks of small firms (size) and stocks of firms with higher book to market values have on average higher returns.

3.4 Determinants of Listed Property Returns

This section of the study investigates various factors that researchers have found to have an influence on stock returns. The literature does provide a theoretical underpinning for most of the factors, however factors such as size is found to have a statistical relationship with returns with no theoretical explanation.

Van Rensburg (1997) suggests that the use of the Gordon-Shapiro constant growth dividend discount model can be used to theoretically justify a possible factor or a determinant of returns.

The Gordon Growth Model is defined as follows:

$$P_t = \frac{D_{t+1}}{(R-g)} \quad (6)$$

Where:

P_t : Price of the asset at time *t*

D_{t+1} : Dividend at time *t+1*

R : Discount rate or expected return

g : Expected constant dividend growth rate, where g > R, else $P_t = \infty$

The equation shows that the price of a security is positively related to both the dividend and the dividend growth rate and negatively related to the discount rate. Chen *et al.* (1986) and Van Rensburg (1997) argue that the market forces that influence returns are factors that influence either dividends (D), the discount rate (R) or the expected dividend growth rate. The magnitude of dividends is effected by the level of earnings or profitability which is broadly effected the general level of economic output (Van Rensburg, 1997). The discount rate is affected by actual interest rate, the yield curve and any changes in the risk premium. Changes in the rate of inflation affect the nominal expected cash flows and the nominal interest rate, therefore according to (Chen *et al.*, 1986) any unexpected changes in inflation will have an impact on valuations.

Chui *et al.* (2003) analyse the cross-sectional determinants of US REITs over the period from 1984 to 2000. However, they separate their analysis into two time periods namely pre-1990 and post 1990. They argue that the structure of the REIT market changed substantially around 1990, affecting risk and return behaviour. Their research indicates that the determinants of returns are not the same in the two periods. Pre-1990 size, high book to market value and analyst coverage were positively related to returns whereas turnover, which is defined as trading volume over a period divided by the number of shares outstanding in the period, was negatively related to returns.

Boshoff (2013) developed a South African listed property valuation model that used firm specific data available in annual financial statements to measure the relationship between the share price and the underlying fundamentals of the company. He provides evidence that the share price movements of property loan stock companies can be forecasted using firm specific characteristics such as leverage, turnover, operating profit, total cost and the prime interest rate.

According to Beechey *et al.* (2000), there exists stock market anomalies which may lead to the predictability of stock returns. Firstly, portfolios which have “value stocks” tend to outperform the market in the long term. Value stocks are defined as stocks which have lower prices relative to its fundamentals such as earnings (low price to earnings ratio), dividends (high dividend yields), tangible assets (low price to net asset value ratio) and cash flows relative to the current stock price. They find evidence that the outperformance of value stocks is not as a result of higher risk. Secondly, their evidence suggests that stocks which have outperformed in the recent past tend to continue this trend in the short term. This pattern is termed momentum. Lastly, they suggest that size (market capitalisation) could play a role in the performance of a stock. They find evidence that small capitalisation stocks exhibit higher expected returns. However, this may be a consequence of small capitalisation stocks being categorized as value stocks.

Akinsomi, Aye*, et al.* (2016) study the determinants of US REITs using data between January 1991 to September 2013. In addition to the traditional factors such as the 3-month Treasury bill, inflation, return volatility, the term spread and the short-term interest rate, they include sentiment and uncertainty indicators in their analyses. Examples of these sentiment and uncertainty indicators are the Kansas City Financial Stress Index (which is an indication of the financial stress within the US), the Index for Consumer Sentiment (leading indicator of the US economy), the US Policy Uncertainty Index (a measure of policy related economic uncertainty) and the Equity Market Uncertainty Index (which is a measure of stock market uncertainty created using key words/articles found in US newspapers). The authors test six forecasting models and find that the Dynamic Model Averaging (DMA) and Dynamic Model Selection (DMS) model produce the most robust results. Their results suggest that the ability of different factors to predict REIT returns changes over time and forecast horizons. From 2005 to 2009 the Kansas City

Financial Stress Index, the 3-month Treasury bill, the inflation rate, and the term spread demonstrated strong predictive power over all time horizons. For the period after 2009 only the Equity Market Uncertainty Index shows strong predictive power over most time horizons.

Authors such as Akinsomi, Kola*, et al.* (2016) investigated the impact of non-financial factors on expected returns. Akinsomi, Kola*, et al.* (2016) examine the performance differential between South African listed property firms which are Black Economic Empowerment (BEE) compliant versus the performance on firms that are not. The South African government established the BEE policy to drive corporate restructuring in firms so that previously disadvantage citizens are given certain opportunities which include ownership, management control, employment equity, skills development, preferential procurement, enterprise development and socio-economic development (Akinsomi, Kola*, et al.*, 2016). Using data from 2006 to 2012, Akinsomi, Kola*, et al.* (2016) find that BBE compliant firms achieved higher returns with lower risk compared to non-BEE compliant peers.

In the sections to follow, the research describes various variables that the literature suggests could have an influence on listed property returns.

3.4.1 Government bond yields

The strong positive correlation between listed property yields and bond yields is expected due to the fixed income nature of South African listed property. Tilly and Jardine (2016) explain that REIT distributions are relatively predictable due to income being based on contractual leases. Listed property distributions are expected to increase regularly and the capital value of the property is expected to appreciate over time compared to the constant coupon value and capital value of a bond (Hook, 2015). Thus, REITs are expected to trade at a premium to bonds with the spread being a reflection of a risk premium as well as growth expectations.

Investors commonly value SA listed property relative to the yield on the SA 10-year government bond (Strydom, 2014). Jankelowitz *et al.* (2016 (a)) explains that investors can gauge the relative expensiveness of listed property by analysing the spread between the yield of SA 10-year government bond and the yield of the SAPY index. The lower this figure indicates that the SAPY is becoming relatively more expensive compared to the bond and vice versa.

According to Motara (2013) the property sector maintained an average premium of 20 basis points relative to the SA government 10 year bond from 2007 to mid-2013. A more recent analysis conducted by Bezuidenhout *et al.* (2016) found that listed property traded at historic yields of around 6.06% at the end of December 2015, a 3.7% (371 bps) premium to the SA 10 year government bond yield of 9.77%. However, one should keep in mind the 35% exposure to offshore counters and that the inclusion of developers which concentrate on capital appreciation rather than distributing earnings effectively reduces the SAPY's income yield (Hook, 2015). By excluding 100% offshore focused counters and non-income distributing capital appreciating focused stocks the historical yield is 7.06%, which results in a premium of 271bps. In both scenarios the evidence suggests that listed property is expensive relative to the bond compared to the historical average (Bezuidenhout *et al.*, 2016).

3.4.2 Interest Rates

Academic research suggests that the three most important market factors that affect REIT returns are the difference in performance relative to general stocks and bonds, changes in interest rates and unexpected inflation. REITs are high yielding investments and are sensitive to interest rate fluctuations (Chan *et al.*, 2003).

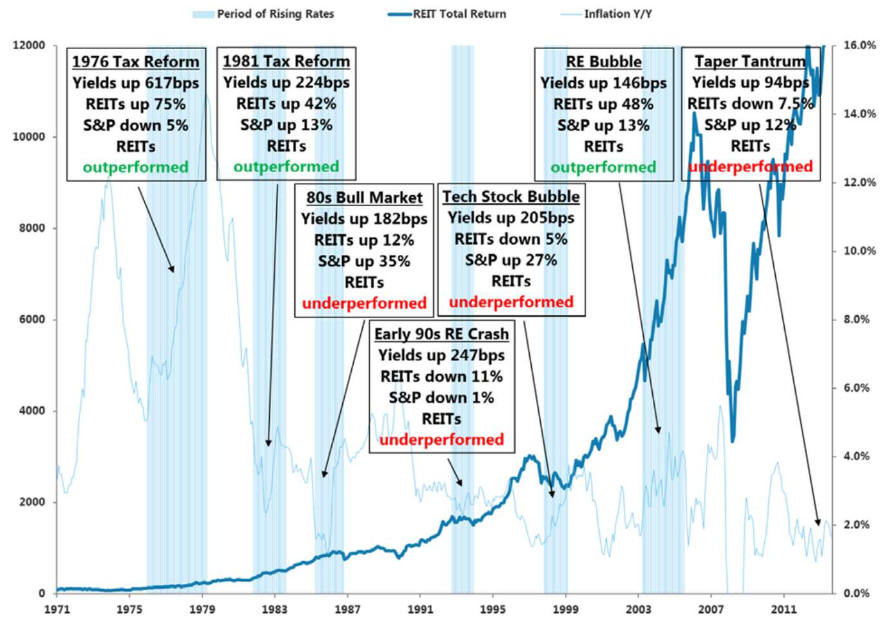
Chan *et al.* (2003) suggest that the variation in REIT returns because of changes in the interest rate depends of the market environment at the time. Block (2011) argues that an increase in interest rates can sometimes slow an economy down which would result in reduced demand for rental properties leading to lower rentals and therefore lower REIT earnings. However, Allison (2014) explains that interest rates are often hiked to cool inflationary pressures due to an expanding economy. In a growing economy demand for space increases, vacancies are reduced and REIT earnings improve. He concludes that the positive effect of a declining vacancy rate outweighs the negative effect of an increase in interest expense in the short to medium term.

On the contrary, if there is a scenario similar to what we are currently experiencing in SA where economic growth is at a low point and inflation is high due to the cost push effect of higher food prices (because of drought), higher energy costs and increasing rates and taxes. Then an increase in interest rates to try and curb inflation expectations will add to the decline in SA's economic growth (Bishop, 2016).

In this case a rising interest rate environment should negatively affect listed property. Block (2011) explains that as interest rates increase the yields on safer government bonds increases. Consequently, REIT yields become less attractive considering its higher risk, resulting in a decrease in demand for REITs. Using a sample of publicly traded US REITs from January 1992 to December 1996, Allen *et al.* (2000) found a significant negative relationship between the change in interest rates and equity REIT portfolio returns.

According to Morgan Stanley Research (2015), the direct effect of interest rates on US REIT stock prices is unclear. They show that US REITs have outperformed the overall US stock market (measured by the S&P 500) in three of the six periods of increasing rate cycles (see figure 5). Furthermore, the correlation between REIT performance and changes in interest rates is historically weak with an R squared of around 38%.

Figure 5: The effect of interest rates on US REIT stock prices



Source: Morgan Stanley Research (2015)

3.4.3 Inflation

It is a common belief that real estate offers investors some protection against inflation because property prices are believed to be positively correlated with the general price level, considering that rentals are a part of the consumer price index (CPI). According to Statistics South Africa (2016) rentals make up 16.2% of the total CPI index for urban areas.

There seems to be no consensus as to whether investment in property is an inflation hedge or not. Hook (2015) argues that the idea of property being an inflation hedge is a myth. She points out that inflation will affect the price of real estate but it is not the only factor. The price of real estate is a function of, inter alia, supply and demand of space, location, interest rates, credit availability, economic conditions, replacement costs, expected returns, unemployment and consumer spending. Inflation affects the price of real estate by increasing the replacement cost of an asset. However, it also increases the operating costs such as maintenance costs, utility costs, insurance and property tax which may negatively affect the net operating income of the asset and consequently the value of the asset (Hook, 2015). Studies conducted by Lu and So (2001) and

Bahram *et al.* (2004) provide evidence that inflation does not Granger cause REIT returns. On the contrary, both studies rather found a negative relationship. Lu and So (2001) argue that a negative relationship is merely a proxy for the relationship between REIT returns and broader macroeconomic factors such as monetary policy and price level. However, using US mortgage REIT data from January 1972 to June 1999, the Bahram *et al.* (2004) analysis rejects the hypothesis that there is a relationship between REIT returns and real economic activity.

Hook (2015) says inflation can have a positive influence if the supply and demand of space is at equilibrium or demand is greater than supply. If these scenarios occur, property owners can increase rentals since the cost to build a new building will be higher and therefore rentals will need to be higher to cover the costs. According to Strydom (2014) the best characteristic of SA listed property is that the distributions paid by listed property firms grow in line with inflation over time. This is possible because most commercial lease agreements generally have an average of 8% escalation per year built into the contract.

In conclusion, evidence suggest that REITs may not be the best inflation hedges in the short term, especially against unexpected inflation. However, over the long term the evidence indicates that REITs can be used as an expected inflation hedge (Chan *et al.*, 2003).

3.4.4 Gross Domestic Product

The South African Reserve Bank (SARB) defines Gross domestic product (GDP) as the measure of goods and services produced within a country's borders during a specified time period. It is one of the main indicators of the performance of a country's economy. Liow (2004) points out that the performance of a stock is a function of the expected future cash flows and these cash flows are dependent on the performance of the economy at that time. In an expansionary phase of the business cycle, demand for goods and services increase. Companies producing these goods and services tend to expand operations (increase supply). Therefore, the demand for space or real estate increases. Furthermore, property takes a significant amount of time to develop. Therefore, in the period between the increase in demand and the completion of new commercial real estate (addition of new supply), the price of rentals tends to increase, increasing operating income for property companies (Liow, 2004). Therefore, a positive relationship between listed property returns and GDP is expected.

3.4.5 Market Capitalisation or Size

Banz (1981) finds a significant negative relationship between the size of a company and the risk adjusted returns. His analysis uses monthly returns data for stocks listed on the NYSE for the 40-year period between 1936 and 1975. He admits that there is no theoretical foundation for a relationship and that the result may be a consequence of size being a proxy for a factor that is correlated with size. A possibility may be that there is a limited amount of information available for smaller firms which makes it more difficult for investors to forecast. Consequently, investors prefer not to hold the stock of smaller firms. According to Banz (1981) firms with a smaller investor base have higher risk adjusted returns. Hamelink and Hoesli (2004) find similar evidence in their investigation of global listed security returns. They used listed property stocks from the ten largest countries by market capitalisation from February 1990 to April 2003 and find a negative relationship between average stock returns and size.

On the contrary Serrano and Hoesli (2007) find a positive relationship between size and US equity REIT returns. Their analysis uses Ordinary Least Squares regression (OLS) with quarterly returns data from 1978 to 2005. Even though they find a positive relationship, it is stronger from 1978 to 1990 than from 1990 to 2005.

3.4.6 Book to Market Value

Chui *et al.* (2003) argue that the benefit of a homogenous sector is that it helps to better understand the different determinants of expected returns. For example, organic growth opportunities and intangible assets generally add very little value to REITs, compared to other industries such as technology where research, development and innovation can lead to very large growth opportunities or at least growth expectations. The book-to-market value ratio is the book value of the company (assets – liabilities = shareholder equity) divided by the market capitalisation. A stock that is either trading at a premium or discount to net asset value (book value) is either overvalued or undervalued, or the price reflects the markets perception of the quality of management. Therefore, there is a positive relationship between book to market values and returns (Chan *et al.*, 2003).

Muller and Ward (2013) and Shapiro (2016) use the inverse of book to market value in their studies. They use the price to net asset value (NAV) which is the ratio of the market capitalisation of the stock to the book value of assets. They find that the price to NAV is a significant factor in their analysis which was negatively related to average returns (i.e. the stocks with the lowest price to NAV ratio had higher average returns.

3.4.7 Leverage

An investor generally uses a portion of debt to purchase property because of its' high capital value (Shapiro, 2016). The total debt ratio or loan to value ratio (LTV) is defined as total debt divided by total assets and is expected to be positively related to returns. Allen *et al.* (2000) explain that leverage magnifies gains or losses from positive or negative investment returns, and therefore firms with higher leverage are considered to be riskier. Property firms with very low gearing are considered to have a conservative capital structure (Block, 2011) and companies with too much leverage can lead to excessive financial stress (Muller and Ward, 2013). Using a sample of all property companies listed on the JSE from December 1999 to December 2015, Shapiro (2016) finds that a portfolio of stocks with loan to value ratios in the second tercile outperforms the portfolios of stocks of over-geared (tercile one) and under-geared stocks (tercile 3). This supports the view that there exists an optimal capital structure (Shapiro, 2016).

3.4.8 Interest Coverage Ratio

Block (2011) explains that the interest coverage ratio is an alternative way of looking at a company's gearing. It is defined as the ratio of a company's earnings before interest, taxes, depreciation and amortization (EBITDA) and its total interest expense. Muller and Ward (2013) argue that the use of income statement ratios is better than balance sheet ratios. If a company's properties are well managed, it may be receiving more than enough EBIT to service the debt, even though the loan to value ratio may be high (Block, 2011). Furthermore, Block (2011) suggests that the interest coverage ratio is a better gauge of gearing during periods of volatility in the LTV ratio as a result of changes in share prices and/or property values. Shapiro (2016) finds similar results to that of the LTV factor. He finds that tercile two performed the best suggesting there exists an optimal interest coverage ratio.

3.4.9 Cost of Debt

Shapiro (2016) explains that firms with a low cost of debt could imply that the firms' management is able to source the cheapest debt or that the portfolio of properties are of better quality (location and build) such that investors are willing to lend at a lower rate because of the lower risk. One must keep in mind that the cheapest debt is not necessarily the most efficient. Block (2011) points out that short term debt like credit lines or revolvers and short term unsecured debt are generally cheap but they are temporary. In an upward interest rate cycle these products are riskier as they will probably need to be re-financed at a higher interest rates in the near future. Shapiro (2016) finds that SA listed property companies with higher average costs of debt achieved the highest compound annual returns (21.7%) over the 20-year period between 1995 and 2015.

3.4.10 Liquidity

The bid-ask spread is the difference between the price at which a stock is being offered to the market (seller) and the price at which an investor is willing to pay for the stock (buyer). In general the larger the spread the less liquid the stock and the more expensive it is to trade (Haugen and Baker, 1996). In addition, a stocks liquidity can be approximated by the market capitalisation (number of outstanding shares multiplied by share price), average monthly trading volumes and turnover defined as volume divided by shares outstanding. According to Haugen and Baker (1996) and Cheng and Roulac (2007) higher liquidity is associated with lower returns. The reasoning they provide is that to keep expected rates of returns after trading costs proportionate, more liquid shares should have lower expected rates of return.

3.4.11 Earnings Yield

Haugen and Baker (1996) argue that firms which are more profitable relative to its peers will have more potential for future growth and consequently greater expected returns. Therefore, profitability measures such as earnings per share (EPS) and return on equity (which is defined as earnings per share divided by equity book value) are expected to be positively related to returns. They find evidence of a positive relationship between variables that approximate cheapness relative to profitability and expected stock returns.

The earnings yield is defined as the earnings per share divided by the share price. Muller and Ward (2013) use earnings yield to differentiate between value stocks and growth stocks. Since value stocks have low price earnings (P/E) ratios and growth stocks have high P/E ratios, the inverse is true. Therefore, value stocks should have high earnings yields and growth stocks should have low earnings yields. Their investigation of the largest 160 stocks on the JSE shows that a portfolio of stocks of companies with high earnings yields tend to outperform a portfolio of peers that have smaller earnings yields. Similarly, Fama and French (1992) found that stocks with higher earnings yields earn on average higher returns.

For listed property company's in South Africa the International Financial Reporting Standards (IFRS) allows for the value of the direct property to be revalued every six months. This fair-value adjustment is a non-cash item that impacts the earnings in the statement of comprehensive income or income statement. Therefore, the dividend yield is a better proxy for actual cash flow movements (Shapiro, 2016).

3.4.12 Dividend Yield and Dividend Growth Rate

Chiang (2015) point out the most research that examines the relationship between dividends and expected returns use the Gordon Growth Model (also called the Dividend Discount Model) as a basis of the analysis. The model illustrates that the price of a security is positively related to both the dividend and the dividend growth rate and negatively related to the discount rate. Chiang (2015) finds that in the period between 1993 and 2011 there is a positive statistically significant predictive relationship between dividend yields and expected returns of US listed REITs. The relationship is stronger in the longer term and their results show that dividend yields are able to predict 34.8% (R^2) of the variation of expected returns at a two-year predictive horizon.

Muller and Ward (2013) find evidence that the dividend yield "style" does exist for JSE listed shares from 1985 to 2011. Their evidence suggests that a large dividend yield portfolio outperforms a small dividend yield portfolio by 12.6% per annum. Similarly, Shapiro (2016) finds a positive relationship between dividend yield and total return. Both, Muller and Ward (2013) and Shapiro (2016) argue that this is relationship is expected to be similar to the earnings yield style as the ability to pay dividends is a function of earnings. Lastly, Shapiro (2016) finds no clear relationship between the dividend growth rate and SA listed property returns.

3.4.13 Price History

Haugen and Baker (1996) point out that there are three technical factors related to price history. Firstly, there appears to be a short-term reversal pattern in stock returns. If the share price increases significantly in one month, they explain that there may be downward pressure on the price in the next month. This could be due to investors trying to "bank" profits leading to more sellers than buyers and downward pressure on the price. Therefore, they expect short term return history (one or two months) to be negatively related to expected returns.

Secondly, Haugen and Baker (1996) argue that there is an inertia imbedded in stock prices. Stocks which have performed well or poorly in the last 6 to 12 months seem to have good or bad prospects, respectively. They argue that investors tend to underreact to strong or poor initial financial results, however these results tend to be followed by similar results in the future. Investors only then fully react to the relevant data. In this case the medium-term returns history (6 to 12 months) is expected to be positively correlated to returns.

Lastly, there may be three to five-year reversal patterns to stock returns. This might be a consequence of investors overreacting to multiple good (bad) earnings reports. With the assumption that similar results will continue long into the future, investors buy (sell) stocks, thereby driving the stock price up (down). As explained above, the stocks prices will tend to reverse in the future. As a consequence the longer term returns history (two to five years) is expected to be negatively correlated to share price returns (Haugen and Baker, 1996).

3.5 Trading Strategies

Chan *et al.* (2003) point out that trying to predict future trading patterns of security prices has been the topic of various research since the creation of the first stock exchanges. The dream of most investors is to create a trading strategy that will consistently earn above average profits. If it is assumed that all available information has already been priced in (efficient markets) no trading strategy will be successful in earning above average profits. In this scenario, an investor is better off using a buy and hold strategy compared to an active trading strategy.

Beechey *et al.* (2000) conclude that some research points to the suggestion that investors could partially forecast stock market returns in contrast to the Efficient Market Hypothesis. In addition, Jensen (1978) collates various studies examining the anomalies and inconsistencies of the EMH. He finds evidence that some trading rules can earn statistically significant economic profits which are a result of market inefficiencies and not deficiencies in the asset pricing model used.

There exists a large amount of research focused on the predictability of equity returns, however Cheng and Roulac (2007) point out that most of the research excludes securitized real estate or REITs. They argue that REITs provide an excellent case study for the CAPM and the Efficient Market Hypothesis since the definition of the sector is clear and it consists of homogenous firms which are well understood by professional and institutional investors. They use a multifactor model based on a set of firm specific characteristics to predict which publicly traded REITs will have the highest ("winners") and lowest ("losers") predicted returns. Using data from 1994 to 2003 their predicted winners outperformed the losers over the entire time period.

Nelling and Gyourko (1998) argue that because REIT income is earned from long term leases to generally credit quality tenants, the cash flow is almost guaranteed and should be more stable and easier to forecast compared to other types of businesses. Furthermore, Cheng and Roulac (2007) find evidence that suggests that stock returns may be more predictable in markets that are perceived as being less efficient. The SA listed real estate market is very "young", the SAPY index was only created in 2002 and the REIT legislation was only introduced in 2013, therefore the SA listed real estate sector could be perceived as less efficient.

3.5.1 Momentum Trading Strategy

The momentum trading strategy is essentially the opposite of the short term reversal pattern (Chan *et al.*, 2003). This strategy assumes that a stock that has performed well in the past will continue to do so and vice versa. Therefore, an investor should buy past outperforming stocks and sell past underperforming stocks.

Jegadeesh and Titman (1993) investigate the use of momentum trading strategies over 3 to 12-month horizon (medium term). Their sample contains daily returns for stocks listed on the NYSE and AMEX from 1965 to 1989. In the absence of trading costs, they find that buying stocks that have performed well in the previous six months and selling stocks that have performed poorly over the same period results in significant excess returns (12.01% per year). Their evidence suggests that the excess returns are due to delayed stock reactions to firm specific information like earnings releases rather than common market factors.

Chui *et al.* (2003) examine the momentum strategy using US REITs pre-and post-1990 and find that the strategy was more profitable in the post 1990 period. They found that the strategy generated profits of 1.33% excess returns per month post 1990 and only 0.3% per month pre-1990 and 0.89% over the entire sample from 1983 to 1999.

Muller and Ward (2013) find that the best time period for measuring momentum is the previous 12 months. They find the momentum style to be the best performing factor in their analysis of JSE listed shares, which shows that the high momentum portfolio outperformed the low momentum portfolio by 18.6% per annum. On the contrary Shapiro (2016) finds no evidence of the momentum effect for SA listed property.

3.5.2 Contrarian Trading Strategy

Jegadeesh and Titman (1993) explain that behavioural finance suggests that humans overreact to information. Similarly, Bondt and Thaler (1985) argue that as a consequence, stock prices also overreact to information. The contrarian strategy is based on the argument that markets will be less efficient in the short term. This is a consequence of less information being available to the market at a point in time and market participants have a shorter time period to react to this information (Chan *et al.*, 2003). Therefore, one could use a contrarian trading strategy to exploit these inefficiencies and earn excess returns. The strategy consists of buying stocks that have underperformed in the past or selling stocks that have outperformed in the past.

Bondt and Thaler (1985) investigate their overreaction hypothesis using monthly returns data of stocks listed on the NYSE between January 1926 and December 1982. By adopting a contrarian trading strategy of buying stocks that have recently underperformed they find that these "loser portfolios" earned on average 19.6% excess returns over a three-year period. Similarly, the portfolio of outperformers underperformed the market over the same period of time.

Haugen and Baker (1996) conduct their regressions using all the stocks in the Russel 3000 Index which are roughly the largest 3000 equities by market capitalisation in the US from 1979 to 1993. Given the above technical factors, they find empirical evidence of the short-term reversal pattern and the medium-term momentum pattern.

Using the time series approach, Nelling and Gyourko (1998) find evidence that monthly equity REIT returns are predictable based on historical returns data. However, interestingly the predictability disappears as the REIT grows in market capitalisation. Their analysis is based on the degree and significance of autocorrelation, which is simply defined as the similarity of a time series and lagged version of the same time series. They find that the contrarian strategy based on monthly returns produces a higher mean return. However, when they included transaction costs such as bid ask spread, commissions and the market impact of the trade, the benefit of forecasting fell away. They therefore conclude that there is no evidence that arbitrage opportunities exist.

3.5.3 Transaction Costs

Ling *et al.* (2000) argue that transaction costs affects an active strategy in two ways. Firstly, it erodes the excess returns and secondly investors will only make trades if the benefit of switching outweighs the cost of the transaction. They estimate the transaction cost to be approximately 0.24% or 24 bps per REIT and non-REIT trade and 0.1% for T-Bills. Similarly, Bharati and Gupta (1992) found that a round trip trade (two trades: one buy one sell) costs approximately 48 bps, however large capitalisation stocks and T-Bills are much cheaper to trade because of their superior liquidity.

3.6 Conclusion

The concept of predicting asset prices has been the topic of various research since the creation of the first stock exchanges (Chan *et al.*, 2003). The EMH forms the foundation on which predictability and asset pricing is built. The EMH states that a market in which prices fully adjust to reflect all information is considered to be efficient (Malkiel and Fama, 1970). A consequence of the EMH is that it is impossible to make economic profits using a specific set of information in a market which is considered efficient, as prices will adjust instantly to the information set (Jensen, 1978). Malkiel and Fama (1970) find evidence that largely supports the weak and semi-strong form of the EMH. However, the strong form of the EMH is the only subset which lacks strong empirical evidence. A further consequence of the EMH is that an investor could optimise long term returns by investing in a passive, low cost index tracking fund instead of an actively managed fund.

The CAPM is one of the fundamental concepts of investment theory and simply states that in a perfectly efficient market the differences in security returns are a function of the risk premium required by an investor for taking market risk and this market risk is sole determinant of differences in expected return (Cheng and Roulac, 2007). Fama and French (2004) point out that the empirical record for the model is poor. The theory that stocks returns relied on one catch-all systemic factor appeared to be unrealistic and as a result researchers began adding more factors to test if they had any effect on stock returns (Silvestri, 2016). This led to the development of the Arbitrage Pricing Theory.

The APT is essentially a multivariate version of the CAPM that calculates the return of a stock based on its sensitivity to movements in macroeconomic, firm specific or market related factors. These sensitivities are termed factor betas, response amplitudes or factor loadings (Roll and Ross, 1980). Research conducted Chen *et al.* (1986) and Ferson and Korajczyk (1995) find evidence that certain factors such as industrial production, changes in the risk premium, and tilts in the yield curve do influence the market; other than what is captured by the CAPM. Fama and French (1993) developed the Fama and French 3-Factor Model which uses the CAPM beta and two firm specific factors namely, market capitalisation (size) and the book to market value. Their evidence suggests that the size of a company is negatively related to average returns and a company's book to market value is significantly positively related to average returns.

Furthermore, the chapter presents a discussion of various macro-economic, market and firm specific factors that have a theoretical or statistical relationship with listed property returns. The literature review makes it clear that the use of a regression analysis to test for relationships is optimal. The literature provides evidence of a positive relationship between listed property returns and government bond yields, book to market value, earnings yield and dividend yield, and a negative relationship with liquidity. There is little consensus as to the relationship between listed property returns and GDP, interest rates, inflation, market capitalisation, leverage and price history.

Lastly, the chapter investigates various trading strategies. The momentum trading strategy assumes that a stock that has performed well in the past will continue to do so and vice versa. Therefore, an investor should buy past outperforming stocks and sell past underperforming stocks. Jegadeesh and Titman (1993) and Chui *et al.* (2003) find empirical evidence that the momentum strategy can potentially generate excess returns. The contrarian strategy is based on the argument that markets will be less efficient in the short term. This strategy consists of buying stocks that have underperformed in the past or selling stocks that have outperformed in the past.

Bondt and Thaler (1985) and Haugen and Baker (1996) find evidence of a short-term reversal pattern which produced returns in excess of market returns.

The literature review finds that majority of the research focuses on forecasting equity returns in developed markets. Research conducted by Fama and French (1993; 1995; 2004) investigate the determinants of general equity returns in the US. Authors such as Nelling and Gyourko (1998), Chui *et al.* (2003), Hamelink and Hoesli (2004), Cheng and Roulac (2007) and Serrano and Hoesli (2007) focus their studies on equity REITs listed in the US. Muller and Ward (2015) and Shapiro (2016) analyse general equity and listed real estate in South Africa and make inferences based on a visual representation of the graphs of the cumulative indices of various portfolios. This study bridges the gap in literature by using portfolio data and regression analyses to investigate the relationship between various factors and South African listed property returns.

The following chapter discusses the research approach, methodology, methods and research techniques adopted in this study. In addition, a description of the data sample, data sources, method of collection and the statistical models is presented. This is followed by an explanation of the hypothesis tests performed.

Chapter 4: Research Methodology

4.1 Introduction

Research can simply be defined as the search for knowledge or the scientific effort of finding something new in any discipline. It is the process of defining a problem, developing a hypothesis, collecting the data, analysing the data, making deductions and conclusions from the data and finally testing these conclusions relative to the formulated hypothesis (Kothari, 2004).

This chapter is dedicated to explaining the research approach adopted in this study. Firstly, it presents an analysis of the methodology which is followed by discussion of the methods and research techniques utilised in this study. Thereafter, it provides a description of the data sample, data sources and method of collection. The chapter then presents the statistical models used to analyse the data. This is followed by an explanation of hypothesis testing and description of the hypotheses tested in this study.

4.2 Research Methodology

Research methodology is different from research methods. Saunders *et al.* (2009) explain that the research methodology is the logic that guides the research and the assumptions chosen form the basis of the research design and methods ultimately used.

Amaratunga *et al.* (2002) explain the fundamental differences between the two epistemological positions which are logical positivism and interpretivism. Positivism searches for evidence of causality or fundamental laws. They point out that logical positivism tests a hypothesis using quantitative and experimental methods. Furthermore, the researcher is required to be independent of the subject of the research. Amaratunga *et al.* (2002) and Saunders *et al.* (2009) explain that interpretivism is an epistemological position which uses qualitative and naturalistic methods to understand the human experience related to the study.

Table 1: Two schools of science

Approach	**Concepts**	**Methods**
Positivism	Social structure Social facts	Quantitative Hypothesis testing
Interpretive Science	Social construction Meanings	Qualitative Hypothesis generation

Source: Amaratunga *et al.* (2002)

According to Saunders *et al.* (2009) the deductive approach is where a theory is developed and a research method and data is used to test the hypothesis. On the other hand, the inductive approach uses the data collected to develop a hypothesis (building the theory). By its very nature, the deductive approach is more associated with positivism and the inductive approach is associated with interpretivism.

Based on the above explanation a research philosophy of positivism is adopted.

4.3 Quantitative versus Qualitative Research Methods

There are two main approaches to conducting research, namely quantitative and qualitative approaches. There are various definitions of both approaches and Magnan and Creswell (1997) provide the best definitions for the two approaches. They define the quantitative research as the investigation of a problem based on testing a hypothesis composed of numerical variables. These variables are then analysed using statistical tools in order to accept, explain or predict if the theory is true. They define qualitative research as the investigation of a problem in a naturalistic setting. The research is conducted using words and analyses the views of different participants to form a holistic picture of the problem. According to Sogunro (2002) the major difference between the two methods is the way data is collected and analysed. Furthermore, he points out that a more comprehensive data set could be collected and analysed using a mixed approach which combines both qualitative and quantitative methods. This involves analysing the qualitative data using tools such as coding, raking and frequency counts. While, statistical analyses such as mean, median and standard deviations give more meaning to the quantitative data.

4.3.1 Characteristics of Quantitative versus Qualitative Research

The table below provides a summary of the differences in characteristics between quantitative and qualitative research methods.

Table 2: Differing Characteristics of Quantitative and Qualitative Research Methods.

Factor	**Qualitative**	**Quantitative**
Data Collected	Soft Data	Hard Data
Data Collection Techniques	Active interaction with sample population (observation by active participation)	Passive interaction through questionnaire and/or experimental design
Sample Population	Small population	Large population
Research Variables	Large number	Small number
Data Collection	On-going observation and interview	Before and after training or experiment
Relationship	Intense and long term with subjects	Distant and short term
Research Context	Uncontrolled	Controlled
Data Analysis	Content/interpretive analyses through themes, patterns, and narrative synthesis, using coding and descriptive statistics, including ranking, frequency, percentages, etc.	Statistical analyses (e.g. descriptive, inferential statistics) using specific procedures such as a Statistical Package for the Social Sciences (SPSS)
Research Findings	Inductive through creativity and critical reflection	Deductive through inferences from data
Research Instruments/Tools	Researcher as an instrument, interview guide, tape recorder, transcriber, computer, type writer, etc.	Questionnaires, computer, calculator, etc.
Interpretation of Information/Results	Subjective nature of enquiry	Objective, Interpretivism, Positivism
Research Tradition	Ethnography, hermeneutics, phenomenography, case studies, etc.	Descriptive, correlational, experimental, causal-comparative, etc.

Source: Sogunro (2002)

4.4 Review of Research Methods

The literature regarding the determinants and predictability of REIT returns is separated into two groups. The first involves portfolio, cross sectional or time series data to analyse REIT expected returns using various macroeconomic, microeconomic, and firm specific variables. This methodology has been applied by Fama and French (1993; 1995; 2012), Allen *et al.* (2000) and Chan *et al.* (2003). The second set of research uses only past return data in time series format to analyse the predictability of REITs. Research such as Liu and Mei (1992) and Nelling and Gyourko (1998) apply this model and argue that it is simpler and more straightforward than the multi factor methodology.

Fama and French (2004) point out that early tests of the CAPM focused on the cross-sectional regression of average returns on estimates of individual security betas. Problems with this method such as measurement errors when trying to explain average returns and a positive correlation in residuals forced researchers such as Jensen *et al.* (1972) to apply the methodology to portfolios instead of individual securities (Fama and French, 2004). Furthermore, they explain that these tests on portfolios resulted in more precise estimates as well as reducing the critical errors in variables issue. However, because of a reduction in power of the statistical test, researchers sorted the individual securities based on betas (i.e. highest beta securities were put in one portfolio and the lowest beta securities in another portfolio). Sorting methodology has become standard practice for empirical tests (Fama and French, 2004).

Fama and MacBeth (1973) address the problem of correlated residuals by estimating month on month cross sectional regressions of returns on beta instead of a single average of the monthly returns. The second step is to calculate the risk premium for each factor by regressing all the asset returns against the beta's calculated in step-one. Fama and French (1992) analyse the relationship between firm level returns and firm specific factors, namely, market beta, size, earnings price ratio, leverage and the book to market value. They performed asset pricing tests based on the cross sectional procedure developed by Fama and MacBeth (1973). Because of the cross-sectional nature of the Fama and MacBeth (1973) method the quality of data is very important and any missing data could reduce the power of the regression (Claessens and Laeven, 2006).

Fama and French (1993) developed the Fama and French 3-Factor Model which uses the time series approach of Jensen *et al.* (1972). Instead of using stock specific data, this method uses portfolios that represent a specific factor. They constructed portfolios based on size (market capitalisation) and value (book to market value) and sorted the portfolios based on ranking. Thereafter the returns of the portfolios with the largest market capitalisations are subtracted from the smallest and similarly with the value factor. The authors then regress the monthly excess returns (stock or bonds) against the excess returns of a market portfolio and the different factor portfolios. According to Fama and French (2004) a regression analysis using diversified portfolios instead of individual stocks improves the precision of the estimated beta coefficients. This methodology forms the foundation of the “style” engine developed by Muller and Ward (2015) and updated by Shapiro (2016).

More modern tests focus on the time series approach. Fama and French (2004) point out that Jensen (1968) was the first to show that the Sharpe-Lintner CAPM also implies a time series regression test. Jensen (1968) showed that the CAPM can be used to evaluate the forecasting ability of a portfolio manager. Jensen (1968) argues that if a portfolio manager was able to forecast future asset prices, the portfolio manager will earn higher returns than what is implied by the Sharpe-Lintner CAPM (equation 2). The time series regression equation for the Sharpe-Lintner CAPM is expressed as follows:

$$E(R_i) - R_f = \alpha_i + \beta_i \left[E(R_m) - R_f\right)] + \varepsilon_i \qquad (7)$$

Where,

α_i : represents the intercept of the regression

ε_i : represents the error term of the regression

Jensen (1968) argues that an implication of the Sharpe-Lintner CAPM is that the intercept term (Jensen's alpha) of the regression is zero for each security or portfolio. Simply put, if the intercept term is significantly different from zero, Jensen (1968) concludes that the portfolio manager has proved that he/she is capable of achieving returns greater than what is expected relative to the risk of the asset. Mose (2014) explains that a positive alpha ($\alpha_i > 0$) implies that a portfolio manager has outperformed the market and a negative alpha ($\alpha_i < 0$) it implies that the portfolio manager has underperformed the market. The logic of Jensen's alpha can be used to evaluate other versions of the CAPM as well as the Arbitrage Pricing Theory allowing one to determine if excess returns can be fully explained by factors within the model.

Serrano and Hoesli (2007) test four asset pricing models using the methodology developed by Fama and French (1993). A linear regression analysis is estimated using ordinary least squares (OLS) methodology and the behaviour of the independent variables is examined through their betas or factor coefficients. Furthermore, the authors point out that these relationships are dynamic and will change over time. Therefore, Serrano and Hoesli (2007) redo the analysis using 5-year rolling OLS regressions. The beta coefficients of these regressions are analysed graphically. Lastly, the out of sample predictive power of each model is analysed using three different forecasting techniques namely, the time-varying coefficient (TVC) regression, a vector autoregressive forecasting technique and the neural networks forecasting technique.

Muller and Ward (2015) point out that the traditional approach to a quantitative analysis of portfolio data is to perform statistical tests on average monthly or quarterly return data. Even though this is necessary to reduce volatility they argue that it may be methodologically weak compared to an analysis of the cumulative returns. For this reason, Muller and Ward (2015) and Shapiro (2016) make inferences based on a visual analysis of the graphs of the cumulative indices of various portfolios.

4.5 Choice of Research Strategy

The choice of research strategy is based on the research aim and research questions set out in chapter one. The problem statement is: by determining which factors could influence South

African listed property returns, one could develop an active trading strategy capable of earning abnormal profits.

The research questions to be addressed are stated as:

a) What macro-economic, market and firm specific factors can consistently explain the return characteristics of South African listed property?

b) Could an active trading strategy based on the predictability of returns generate greater than market returns?

Based on the explanations above the research philosophy of positivism is adopted. Furthermore, the research uses quantitative methods to analyse a set of numerical secondary data.

The first research question is addressed using the methodology developed by Fama and French (1993) and the style engine developed by Muller and Ward (2013). Similar to Serrano and Hoesli (2007) the research tests four asset pricing models using linear regression analysis estimated using OLS methodology. Firstly, the appropriateness of each model is testing using Jensen (1968) methodology. Thereafter, the relationships are analysed via the independent variable's beta coefficients, over both the full sample period and using a graphical analysis of a 5-year rolling sample. To answer the second research question, the research adopts the approach of Serrano and Hoesli (2007) to test the out of sample predictive power of each of the models using the VAR forecasting technique.

4.6 Research Design

4.6.1 Data

All indices data used are monthly total returns for the period from January 1996 to December 2015. For South African listed property, the JSE SAPY is only available from March 2002. Data from January 1996 to February 2002 was obtained from Bradfield *et al.* (2015). The data from January 1996 to February 2002 is an index comprising of the Property Unit Trust Index and

Property Loan Stock Index, weighted according to their market capitalisation. For the overall stock market the JSE All Share Index (ALSI) is used and for bonds the JSE All Bond Index (ALBI) is used. As a risk-free rate the study make use of the South African Three-month T-bill rate. The South African prime interest rate and inflation was extracted from the INET data base. Quarterly gross domestic product (GDP) data was extracted from the South African Reserve Bank (SARB). The study assumes that the growth rate for each month in a specific quarter was equal to the quarter end growth rate.

The portfolio data chosen for this study were obtained from the Muller and Ward (2015) database which was updated by Shapiro (2016). The initial database was created using all the stocks listed on the main board of the JSE over a 27 year period between 1985 to 2011 using INET and individual financial statements (Muller and Ward, 2013). Shapiro (2016) updated the database to include listed property stocks from 2012 to 2015 as well as certain property specific data for each property company which were not part of the original data set.

Muller and Ward (2013) and Shapiro (2016) made the following adjustments to the data:

- The data was backward adjusted to take into account share splits or share consolidations.
- When a spinoff occurred the returns of the "SpinCo" were included in the parent company until the end of the quarter. Thereafter, the companies were treated separately.
- Total returns were used for the stocks, since dividends forms a significant portion of total returns over time. Furthermore, script dividends (an issue of shares to the value of the dividend) were included, however, share buybacks are excluded.
- Shares that form part of compensation schemes were ignored.
- Newly listed companies were added to the dataset at the start of the following quarter and delisted shares were removed at the end of the quarter based on the last traded price. This mitigates the risk of survivorship bias (the act of ignoring shares which have been delisted).
- According to Muller and Ward (2013), look ahead bias occurs because of the difference between a company's financial year end and when the company makes those financial

results available to the public. Datasets generally record financial data as at the company's year-end date and not the date of release. To account for the look ahead bias the accounting variables were lagged by three months after the official year-end date.

- Name changes of companies which do not change their structure are treated as the same entity.
- Daily return data points greater than 40% and smaller than -40% were considered outliers and were removed.

Shapiro (2016) final dataset consists of only property companies listed on the JSE from January 1996 to December 2015. Below is a list of all the property companies listed on the JSE between 1978 and 2015 which Shapiro (2016) extracted from INET BFA and the Muller and Ward (2015) database.

Table 3: Population of all Listed Property Tickers on JSE from 1978 - 2015

Ticker Code	**Name**	**Listing Date**	**Status**
ABT	Ambit Properties Ltd	06-Feb-04	Delisted
ABY	Abbey Holdings Limited	08-Jul-85	Delisted
ACP	Acucap Properties Ltd	08-Apr-02	Delisted
ACS	Acsion Limited	09-Dec-14	Delisted
ADV	Advent Properties Ltd	18-Dec-91	Delisted
AIA	Ascension Prop Ltd A	15-Jun-12	Listed
AIB	Ascension Prop Ltd B	15-Jun-12	Listed
ANP	Annuity Properties Ltd	04-May-12	Delisted
APA	Apexhi Properties -A-	05-Mar-01	Delisted
APB	Apexhi Properties -B-	30-Nov-01	Delisted
APF	Accelerate Prop Fund Ltd	12-Dec-13	Listed
ARO	Anglo American Properties Ltd	31-Jan-78	Delisted
ATS	Atlas Properties Ltd	16-Jun-88	Delisted
ATT	Attacq Limited	14-Oct-13	Listed
AWA	Arrowhead Properties A	09-Dec-11	Listed
AWB	Arrowhead Properties B	09-Dec-11	Listed
AXC	Apexhi Properties -C-	09-Oct-06	Delisted
BNT	Bonatla Property Hldgs	24-Oct-97	Delisted
BPP	Barprop Ltd	30-Jun-98	Delisted
BPR	Barprop Ltd	02-Oct-85	Delisted
BST	Bester Beleggings Beperk	31-Jan-78	Delisted

CBD	Cbd Property Fund	31-Dec-81	Delisted
CBS	Cbs Property Portfolio	02-Nov-05	Delisted
CCO	Capital & Counties Prop Plc	10-May-10	Listed
CEN	Centrecity Property Fu	31-Dec-80	Delisted
CLO	Calulo Property Fund Ltd	08-Mar-04	Delisted
CPF	Capital Property Fund Ltd	31-Aug-84	Listed
CPS	Compass Property Holdings	04-Jul-88	Delisted
DIA	Dipula Income Fund A	19-Aug-11	Listed
DIB	Dipula Income Fund B	19-Aug-11	Listed
DIV	Diversified Prop Fund Ld	06-Oct-05	Delisted
DLI	Delta Int Prop Hldg Ltd	31-Aug-12	Listed
DLT	Delta Property Fund Ltd	02-Nov-12	Listed
DSA	Disa Development Corporation	23-Oct-87	Delisted
EMI	Emira Property Fund	28-Nov-03	Listed
EQR	Equikor Holdings Ltd	16-Jul-85	Delisted
EQU	Equites Prop Fund Ltd	18-Jun-14	Listed
FDP	Freedom Prop Fund Ltd	12-Jun-14	Listed
FFA	Fortress Inc Fund Ltd A	22-Oct-09	Listed
FFB	Fortress Inc Fund Ltd B	22-Oct-09	Listed
FPT	Fountainhead Prop Trust	30-Jun-83	Listed
FSP	Freestone Property Hldgs	30-Aug-01	Delisted
FVT	Fairvest Property Hldgs	25-May-98	Delisted
GPR	Grove Property Fund Ltd	13-Sep-85	Delisted
GRT	Growthpoint Prop Ltd	30-Nov-87	Listed
HGT	Higate Property Fund	30-Nov-87	Delisted
HPA	Hospitality Prop Fund A	16-Feb-06	Listed
HPB	Hospitality Prop Fund B	16-Feb-06	Listed
HST	Highstone Property Fund	20-Sep-90	Delisted
HYP	Hyprop Inv Ltd	25-Feb-88	Listed
IAP	Investec Australia Prop Fd	24-Oct-13	Listed
IFR	Ifour Properties Ltd	18-Jun-02	Delisted
ILU	Indluplace Properties Ltd	19-Jun-15	Listed
ING	Ingenuity Property Inv	02-Jul-01	Listed
IPF	Investec Property Fund Ltd	15-Apr-11	Listed
IPR	Iprop Holdings Ltd	27-Nov-87	Delisted
ITU	Intu Properties Plc	24-Jun-99	Listed
KHO	Kirchmann-Hurry Properties	28-Sep-90	Delisted
LDO	Lodestone Reit Limited	25-Feb-15	Listed
MCP	Micc Property Income Fnd	09-Oct-03	Delisted
MDN	Madison Prop Fund Mngrs	07-Jun-06	Delisted
MIL	Millennium Property Holdings	11-Dec-86	Delisted
MIP	Merchant & Ind Prop Ltd	26-Feb-90	Delisted

MNO	Main Street Property Fund	23-Jan-91	Delisted
MPL	Metboard Properties Lt	22-May-98	Delisted
MSP	Mas Real Estate Inc.	31-Aug-09	Listed
MTP	Martprop Property Fund	03-Nov-99	Delisted
MYT	Monyetla Property Fund Ltd	07-May-07	Delisted
NEP	New Europe Prop Inv Plc	17-Apr-09	Listed
NFP	New Frontier Prop Ltd	08-Apr-15	Delisted
NPT	Newport Property Fund	11-Jan-94	Delisted
NVT	Nk Properties Ltd	30-Jan-96	Delisted
OAS	Oasis Crescent Prop Fund	23-Nov-05	Listed
OCT	Octodec Invest Ltd	26-Sep-90	Listed
ORE	Orion Real Estate Ltd	18-Aug-03	Listed
PAP	Pangbourne Prop Ltd	23-Jul-87	Delisted
PFN	Consolidated Property and Fin	04-Feb-85	Delisted
PIC	Picardi Properties Limited	21-Jan-85	Delisted
PIV	The Pivotal Fund Ltd	08-Dec-14	Listed
PMG	Primegro Properties Ltd	17-Jan-00	Delisted
PMM	Premium Properties Ltd	27-Jun-95	Delisted
PNR	Pioneer Property Fund	31-Jan-78	Delisted
PPR	Putprop Ltd	14-Aug-89	Listed
PRA	Paramount Prop Fund Ltd	14-Mar-89	Delisted
PRM	Prima Property Trust	31-Jan-78	Delisted
QPG	Quantum Prop Group Ltd	13-Oct-08	Listed
RAB	Rabie Investment Holdings Ltd	04-Aug-89	Delisted
RDF	Redefine Properties Ltd	17-Jul-00	Listed
REB	Rebosis Property Fund Ltd	17-May-11	Listed
RES	Resilient Prop Inc Fund	06-Dec-02	Listed
RHW	Richway Retail Prop Ltd	05-Jul-94	Delisted
RIN	Redefine Prop Int Ltd	07-Sep-10	Delisted
ROC	Rockcastle Global Real Estate	26-Jul-12	Listed
RPL	Redefine International P.L.C	28-Oct-13	Listed
RPR	Rand Leases Properties Ltd	26-Feb-92	Delisted
SAC	Sa Corp Real Estate Fund	11-Dec-06	Listed
SAR	Safari Investments Rsa Ltd	07-Apr-14	Listed
SBL	Sable Holdings Ltd	30-Nov-83	Delisted
SGA	Synergy Inc Fund Ltd A L/U	19-Dec-11	Listed
SGB	Synergy Inc Fund Ltd B L/U	21-Dec-11	Listed
SGR	Sage Property Holdings	25-May-88	Delisted
SJL	S and J Land Holdings	05-Dec-95	Delisted
SMP	Saambou Properties Limited	02-Aug-91	Delisted
SNL	Sanland Property Trust	31-Jan-78	Delisted
SPE	Spearhead Prop Hldgs Ltd	10-Nov-99	Delisted

SRE	Sirius Real Estate Ltd	05-Dec-14	Listed
SRL	Sa Retail Properties Ltd	03-Dec-01	Delisted
STP	Stenprop Limited	12-Dec-14	Listed
SYA	Siyathenga Property Fund	08-Aug-05	Delisted
SYC	Sycom Property Fund	25-Nov-86	Listed
TAM	Tamboti Property Fund	25-Jun-86	Delisted
TEX	Texton Property Fund Ltd	12-Aug-11	Listed
TMK	Tomkor Ltd	30-Nov-83	Delisted
TWR	Tower Property Fund Ltd	19-Jul-13	Listed
UMN	Umdoni Property Fund	31-Oct-83	Delisted
VIF	Vividend Income Fund Ltd	18-Nov-10	Delisted
VIS	Visual International Hldgs Ltd	23-May-14	Delisted
VKE	Vukile Property Fund Ltd	24-Jun-04	Listed

Source: Shapiro (2016)

Shapiro (2016) applied a minimum liquidity requirement to all the shares and excluded shares which had a median daily value traded over a period of 12 months less than one million rand deflated by 20% per year. This made sure that the largest 20 companies in the total population of listed property companies at a specific point in time formed part of the sample.

4.6.2 Style Engine

A style engine is a tool constructed in Microsoft Excel and written in VBA (Visual Basic) to process data (Muller and Ward, 2013). The style engine used only the listed property dataset explained above to create three equally weighted portfolios for each style or factor (Shapiro, 2016). The style variables are size, momentum, liquidity, dividend yield, price to NAV, earnings yield, dividend growth, average cost of debt, loan to value ratio and the interest coverage ratio (each factor is defined in table 4 below).

All the companies are ranked from highest to lowest with respect to each style variable. Thereafter, each stock is placed in either a high, medium or low portfolio based on its ranking. If the number of stocks that passed the liquidity test is not divisible by three, the high and medium will have the same number of stocks with the low tercile absorbing the extra one or two remaining stocks. The liquidity test and rankings are redone every quarter and new portfolios are created ignoring any transaction costs (Muller and Ward, 2013). The final data set is monthly performance for each style factor for each tercile (Shapiro, 2016).

Similar to Fama and French (1993) this study takes the monthly return of the high tercile and subtracts the monthly return of the low tercile. For example, the size variable is the monthly returns of the large market capitalisation portfolio (T1) minus returns of the smallest market capitalisation portfolio (T3). According to Shapiro (2016) subtracting the performance of the high tercile from the low tercile (T1 – T3) is equivalent to buying or going long an investment in the high tercile portfolio and selling or going short the low tercile portfolio. This was done for each style.

Shapiro (2016) points out that prior to 2000 leverage was rarely used especially because the Property Unit Trust legislation restricted the use of debt. Therefore, leverage data (loan to value and interest coverage ratio) is only available from January 2000 to December 2015. Furthermore, monthly excess returns of the SAPY, ALSI and ALBI are used, which is defined as the monthly return minus the monthly risk-free rate (South African 3-month T-bill).

Table 4: Data Definitions

Style / Factor / Variable	**Name**	**Definition / JSE Code**
SA Property Total Return Index (SAPY)	r_{sapy}	J253T and Bradfield *et al.* (2015)
JSE All Share Total Return Index (ALSI)	r_{all}	J203T
JSE All Bond Index (ALBI)	r_{albi}	ALBI
SA Risk-free Rate	r_f	South African three-month T-bill rate
Inflation	$Inflation$	Stats SA CPI year on year % change
Interest Rate	$Int\ Rate$	SARB prime interest rate
GDP Growth Rate	GDP	Quarter-on-quarter, seasonally adjusted and annualised growth rate
Momentum	$Momntm$	Total return over the previous 12 months
Size	$Size$	Market capitalisation
Liquidity	$Liquid$	Value of shares traded divided by market capitalisation
Dividend Yield	$Div\ Yld$	Dividends per share divided by the share price
Price to NAV	$PNAV$	Ratio of price to net asset value
Earnings Yield	$Earn\ Yld$	Earnings per share divided by the share price
Dividend Growth	$Div\ Grw$	Dividend growth over the past 12 months
Average Cost of Debt	$Cost\ Debt$	Average cost of debt
Loan to Value	LTV	Interest bearing debt divided by property assets
Interest Coverage Ratio	$Int\ Cov$	Interest cost divided by net rental income

Source: Author, Muller and Ward (2013) and Shapiro (2016)

4.6.3 Models Employed

Serrano and Hoesli (2007) make use of four different models to explain the historical returns of listed property in the US. Similarly, the analysis starts by determining the appropriateness of four different models in explaining the historical returns of the South African Listed Property Index. Firstly, the study examines the Capital Asset Pricing Model of Sharpe (1964) since it is one of the fundamental concepts of investment theory. Thereafter, the Fama and French (1993) 3-Factor model which adds size and book to market value to the CAPM is analysed. It must be noted that instead of book to market value the inverse or price to NAV ratio is used. The third model examines the relationship between the SAPY, the JSE All Share Index and the JSE All Bond Index. The final model (model 4) investigates the relationship of the SAPY against all the variables listed in table 4 above. Each model is estimated using ordinary least squares (OLS) methodology. The behaviour of the independent variables is examined through their betas or factor coefficients (Serrano and Hoesli, 2007). Furthermore, the relationship between the SAPY and the independent variables are expected to change over time. Therefore, similar to Serrano and Hoesli (2007) a graphical analysis of the beta coefficients over a 5-year rolling period is conducted. Lastly, the predictive power of each model is analysed using the vector autoregressive forecasting technique.

Model 1: Capital Asset Pricing Model of Sharpe (1964)

$$r_{sapy,t} = \alpha + \beta_{alsi} r_{alsi,t} + u_t \tag{8}$$

Model 2: Fama and French (1993) 3-Factor Model

$$r_{sapy,t} = \alpha + \beta_{alsi} r_{alsi,t} + \beta_{size} Size_t + \beta_{PNAV} PNAV_t + u_t \tag{9}$$

Model 3: CAPM plus Bond Factor Model

$$r_{sapy,t} = \alpha + \beta_{alsi} r_{alsi,t} + \beta_{albi} r_{albi,t} + u_t \tag{10}$$

Model 4: All Factor Model - SAPY versus macroeconomic, market and firm specific factors

$$r_{sapy,t} = \alpha + \sum_{i=1}^{n} \beta_i Y_{i,t} + u_t \tag{11}$$

$$\begin{aligned} r_{sapy,t} = {} & \alpha + \beta_{alsi} r_{alsi,t} + \beta_{albi} r_{albi,t} + \beta_{Int\ Rate} Int\ Rate_t + \beta_{Inflation} Inflation_t \\ & + \beta_{Momntm} Momntm_t + \beta_{size} Size_t + \beta_{Liquid} Liquid_t + \beta_{Div\ Yld} Div\ Yld_t \\ & + \beta_{LV} PNAV_t + \beta_{Earn\ Yld} Earn\ Yld_t + \beta_{Div\ Grw} Div\ Grw_t + \beta_{Cost\ debt} Cost\ Debt_t \\ & + \beta_{LTV} LTV_t + \beta_{Int\ Cov} Int\ Cov_t + u_t \end{aligned}$$

4.6.4 Vector Autoregression (VAR)

The study adopts the vector autoregressive (VAR) forecasting technique which is a natural extension of the univariate autoregressive model (AR) used to capture the linear interdependencies among multiple time series (Serrano and Hoesli, 2007). The basic VAR model has the form:

$$r_{sapy,t} = \beta_0 + \sum_{i=1}^{n} \beta_i Y_{t-1} + u_t \tag{12}$$

Where:

Y : is the vector of variables included in the model

i : is the number of lags of the variable as determined by the Akaike's (AIC) and Schwarz's Bayesian (BIC) information criteria. The model with the lowest AIC and BIC values is considered to be optimal.

To test the predictive power of each of the models the study forecasts each model using out-of-sample data. The sample is split into two data sets, a development data set and a validation data set. The out of sample forecasts are calculated using approximately 25% of the available data set. Therefore, the development data set ranges from January 1996 to December 2009 and the validation data set ranges from January 2010 to December 2015.

The predictive models 1, 2 and 3 use all the variables as defined in the equations above. However, instead of using all the variables for model 4, a Stepwise Selection process is used to select only the most optimal variables. According to NCSS (2016) Stepwise Selection combines the statistical techniques of Forward Selection and Backward Elimination. Forward Selection begins with no variables in the model and adds, one by one, only the variables with the highest statistical significance. Backward Elimination starts with all the independent variables and deletes variables with the lowest statistical significance until only the most optimal variables (relative to a specific level of significance) remain.

4.6.5 Assessing Performance

Similar to Serrano and Hoesli (2007) the following traditional loss functions is used to test the predictive power of the four models:

Mean Error (ME)

Mean Error, also referred to as mean signed difference (MSD) or mean signed error (MSE) is a sample statistic that measures how well the model estimates a value compared to the actual value. The MSE is defined as:

$$ME = \frac{1}{n}\sum_{i=1}^{n}\left(\hat{y}_t - y_t\right) \tag{13}$$

Where:

$\hat{y}_t$: is the forecasted value of the independent variable

y_t : is the actual value of the independent variable

The disadvantage of this statistic is that the large positive and negative forecast errors cancel themselves out.

Root Mean Squared Error (RMSE)

The root mean squared error is a quadratic loss function that solves the problem of the ME (i.e. large positive and negative forecast errors cancelling themselves out). The RMSE is defined as follows:

$$RMSE = \sqrt[2]{\frac{\sum_{i=1}^{n}(\hat{y}_t - y_t)^2}{n}} \tag{14}$$

Mean Absolute Error (MAE)

The mean absolute error is the average of the absolute value of the error terms. This function also solves the problem of the large positive and negative forecast errors cancelling themselves out. The MAE is defined as follows:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}\left|\hat{y}_t - y_t\right| \tag{15}$$

Directional Accuracy

Directional accuracy measures the percentage of times the model forecasts the correct direction (up/down movement or positive/negative movement) of the dependent variable. Directional accuracy is defined as follows:

$$MDA = \frac{1}{N}\sum_t 1_{sign(y_t - y_{t-1}) == sign(\hat{y}_t - \hat{y}_{t-1})} \tag{16}$$

Theil's U2 inequality coefficient

Theil's U^2 inequality coefficient is based on the RMSE explained above. Serrano and Hoesli (2007) explain that U^2 statistic is based on a "Type-1 Naive" 1-step forecast model which compares the predicted value to a model that assumes that the next value is the same as the current value (i.e. $y_{t+1} = y_t$). The closer the value of the U^2 statistic is to zero the better the forecasting capability. The U^2 statistic is defined as:

$$U_t^2 = \frac{\sum_{i=1}^{n}(\hat{y}_t - y_t)^2}{\sum_{i=1}^{n}(y_t - y_{t-1})^2} \tag{17}$$

4.7 Hypothesis Testing

Gujarati (2003) explains that the confirmation or rejection of economic theories based on sample evidence is known as statistical inference or hypothesis testing. As explained in section 4.6.3 the study will use OLS regression to estimate each of the four models. The following step is to determine if these estimates are in line with expectations of the theory (Gujarati, 2003). In all three of the tests, the study will draw inference based on two alternate outcomes of the intercept, beta coefficients, or difference in means. The null hypothesis will be that the test-coefficient is equal to zero and the alternative hypothesis is that the test-coefficient is not equal to zero (either higher or lower than zero). Therefore, as Mose (2014) points out that all the tests will be two-tailed tests. Based on this, if the test-coefficient is significantly different from zero one fails to reject the null hypothesis and accepts the alternative hypothesis. Gujarati (2003) explains that the conclusion to reject or fail to reject the null hypothesis is based on the level of significance or the probability of committing "type I" error which is the probability of rejecting a true hypothesis. According to Mose (2014) common practice is to use a 5% level of significance (95% confidence).

4.7.1 Test of appropriateness of models

The first test is based on determining if each model fully explains the pattern of expected returns of the South African Listed Property Index. This involves a test to detect whether the intercept term (Jensen's alpha) is significantly different from zero. Therefore, the hypothesis test can be stated as follows:

$$\mathbf{H_0}: \alpha_i = 0$$

$$\mathbf{H_1}: \alpha_i \neq 0$$

If the null hypothesis cannot be rejected (i.e. the intercept term is not statistically different from zero) the test concludes that no alpha is being created and that excess returns are fully explained by factors within the model and therefore the model fully captures the pattern of expected returns of the SAPY. If the null hypothesis is rejected, alpha is being created and the test concludes that the model is not able to fully explain the returns of the SAPY.

4.7.2 Test of determinants of listed property returns

To test if there is a statistically significant relationship between a factor and returns of the South African Listed Property Index, the following hypothesis is tested:

H0: $\beta_i = 0$

H1: $\beta_i \neq 0$

If the null hypothesis cannot be rejected (i.e. the beta term is not statistically different from zero) the test concludes that the factor has no statistically significant relationship with excess returns. If the null hypothesis is rejected, then the test concludes that there is a statistically significant relationship between the factor and returns of the South African Listed Property Index.

4.7.3 Test of active versus passive returns performance

To test if the out-of-sample returns generated by the active models are significantly different from the actual returns achieved by the passive investment strategy the study uses the paired two sample for means t-Test. This test is used to determine if the means of two related samples are significantly different from each other. The hypothesis tested is as follows:

H0: $\mu_1 = \mu_2$

$$\mu_1 - \mu_2 = 0$$

H1: $\mu_1 \neq \mu_2$

$$\mu_1 - \mu_2 \neq 0$$

If the null hypothesis cannot be rejected (i.e. the difference between the sample means term is not statistically different from zero) then the test concludes that there is no significant difference between returns generated by the active model and the actual returns of the passive investment. If the null hypothesis is rejected, then the test concludes that there is a statistically significant difference between the returns generated by the active model and the actual return of the passive investment.

4.8 Conclusion

This chapter explains the research approach adopted in this study. Based on the research aim and research questions the study adopts a research philosophy of positivism. Furthermore, the quantitative research method will be used to determine what factors influence South African listed property returns and if these returns can be consistently forecasted and used to develop an active trading strategy capable of outperforming the market.

To achieve the research objectives a statistical analysis will be carried out on a set of secondary numerical data. This data includes South African listed property Index (SAPY) excess returns and various portfolio returns data extracted from INET and Muller and Ward (2015) database (which was updated by Shapiro (2016)). These portfolios are generated using a “style engine” developed by Muller and Ward (2015) which creates equally weighted portfolios based on the ranking of the stocks for a specific style variable. The sample extends over a 20-year period from January 1996 to December 2015.

Furthermore, the chapter presents four models that will be used to explain the historical returns of the SAPY. Firstly, the Capital Asset Pricing Model of Sharpe (1964) is examined since it is one of the fundamental concepts of investment theory. The second model is the Fama and French (1993) 3-Factor model, which adds size and book to market value to the CAPM. The third model examines the relationship between the SAPY, the JSE All Share Index and the JSE All Bond Index. Lastly, model 4 investigates the relationship of the SAPY against all the variables listed in table 4 above. Ordinary least squares regression is used to determine the appropriateness of each model. Furthermore, because these relationships change over time, a 5-year rolling regression analysis is used to understand the relationships over time.

The chapter introduces the vector autoregressive forecasting technique, which will be used to test the predictive power of each model. The predictive power is tested using traditional loss functions such as mean error, root mean squared error, mean absolute error, directional accuracy and Theil's U^2 inequality coefficient.

Lastly, the chapter presents a discussion of hypotheses testing and provides a description of the hypotheses tested in this study.

The following chapter will present an analysis and interpretation of the data and the results of the regression analysis as well as the testing and outcomes of the hypotheses.

Chapter 5: Analysis of Data

This chapter will present a description of the data and an interpretation of the results. The data is analysed and tested for robustness to ensure any regressions are valid. This is followed by an analysis of the regression results for each model, which will allow us to make inferences on relationships and strength of predictive power. Finally, because of the dynamic nature of the relationships a rolling regression is conducted to assess how these relationships and predictive power change over time.

5.1 Descriptive Statistics

Table 5 below summarises the statistical characteristics of the data set used. The data consists of monthly data from January 1996 to December 2015 which is equivalent to 240 data points for each variable. However, as shown in table 5 below, there are 48 data points missing for both the Loan to Value and the Interest Coverage variables. As explained in Chapter 3, this is a result of leverage rarely being used by listed property companies prior to 2000.

The average monthly excess returns for the SAPY, ALSI and ALBI is approximately 0.89%, 0.55% and 0.18%, respectively. Therefore, on average listed property outperformed both general equities and bonds on a monthly basis. Standard deviation is a measure of risk or volatility. It is found that the excess returns of the SAPY, ALSI and ALBI have a standard deviation of 4.69%, 5.53% and 2.54%, respectively. This means that the excess returns of the ALSI experience the most volatility, with the ALBI experiencing the least volatility. The range of monthly performance can also be a proxy for risk (Moyer, 2008). The minimum and maximum monthly excess return achieved by the SAPY (-14.5% and 17.2%) was higher on both ends compared to the All Share index (-31.1% and 13.1%). Similar to Moyer (2008) and Bradfield *et al.* (2015) the study finds that the volatility of listed property lies between that of general stocks and bonds. Our data shows that listed property is less risky than general equity and produces higher excess returns.

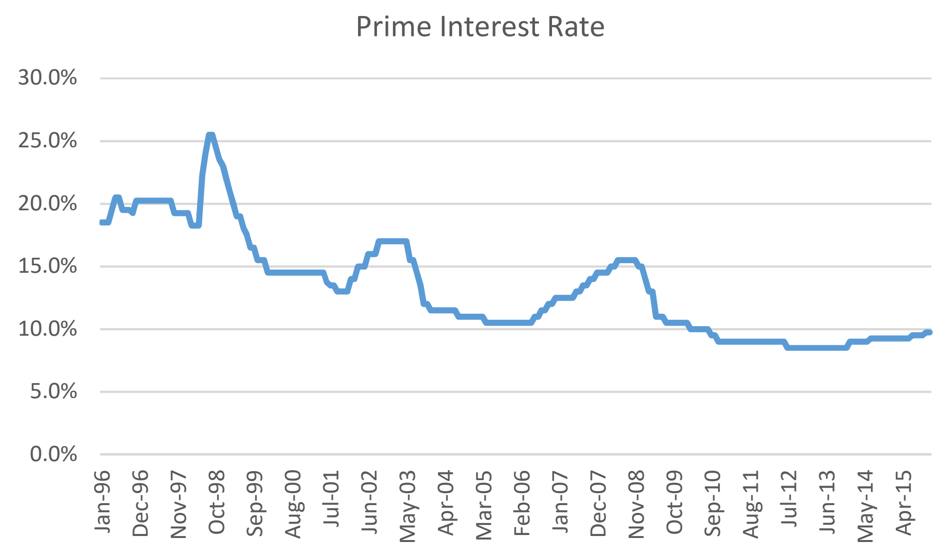
Table 5: Descriptive Statistics

Factor	Frequency	Mean	Standard Deviation	Minimum	Maximum	Median	Missing Data
SAPY Excess Returns	240	0.89%	4.69%	-14.52%	17.25%	1.16%	0
ALSI Excess returns	240	0.55%	5.53%	-31.11%	13.06%	0.63%	0
ALBI Excess returns	240	0.18%	2.54%	-16.27%	9.73%	0.33%	0
Momentum	240	-0.64%	5.17%	-24.71%	12.51%	-0.21%	0
Size	240	-0.45%	5.02%	-25.71%	19.97%	-0.73%	0
Liquidity	240	0.13%	5.20%	-16.06%	29.03%	-0.38%	0
Dividend Yield	240	0.30%	5.12%	-19.63%	26.81%	0.29%	0
Price to NAV	240	-0.31%	4.71%	-17.61%	15.34%	-0.44%	0
Earnings Yield	240	0.40%	5.16%	-19.63%	26.81%	0.51%	0
Dividend Growth	240	0.01%	5.30%	-21.44%	25.90%	0.39%	0
Average Cost of Debt	240	0.22%	4.95%	-25.05%	27.80%	0.19%	0
LTV	240	-0.23%	3.59%	-13.78%	10.56%	-0.52%	48
Interest Coverage Ratio	240	-0.12%	4.33%	-13.78%	25.21%	-0.06%	48
Inflation	240	6.04%	2.61%	0.20%	13.00%	5.90%	0
Prime Interest Rate	240	13.30%	4.13%	8.50%	25.50%	12.50%	0
GDP Growth	240	2.95%	2.42%	-6.10%	7.70%	3.15%	0

Table 5: Descriptive Statistics

Table 5 shows that the average prime interest rate is 13.3% over the 20-year period. However, when one plots the prime interest rate over time it shows a downward trend (see figure 6 below). In addition, interest rates have been relatively flat since early 2011. This lower and more stable interest rate environment makes the yields on listed property more attractive relative to bonds (Block, 2011). Therefore, there is a higher demand for listed property shares which could have been one of the reasons listed property has outperformed the other asset classes.

Figure 6: Prime interest rate



Source: Author, INET, MS Excel

Table 5 shows that the average rate of inflation over the past 20 years is approximately 6.0%. The average commercial real estate rental agreement in South Africa has an annual escalation clause of between 8% and 10% (Buchner, 2010). Therefore, the evidence suggest that listed property can be used as an inflation hedge over the long term.

The average seasonally adjusted, quarter on quarter annualised growth rate of the real gross domestic product (GDP) at market prices was 2.95% over the past 20 years. The minimum GDP growth rate was -6.1% recorded in the first quarter of 2009 during the global financial crises.

5.2 Correlation Matrix

Table 6 below presents a Pearson's' correlation table which is used to examine any potential linear relationships between variables. The correlation coefficient represents the direction and strength of the relationships. It must be noted that correlations do not specify the causality of the relationship. The correlation matrix only uses data from January 2000 to December 2015, because of the missing data for LTV and Interest Coverage Ratio variables. Only correlations that were significant at a 5% level are interpreted, these results are written in bold in table 6.

The results show a significant positive relationship between the SAPY, the ALSI and the ALBI. Moyer (2008) argues that this positive relationship means that all asset classes are at least being affected by the same macroeconomic drivers. The correlation between the SAPY and the ALBI is relatively high at 0.65 compared to the correlation between the SAPY and the ALSI at 0.24. This is evidence that over the 20-year time period investigated, listed property behaved more like bonds than general equity. In addition, the relationship between listed property and bonds is expected as listed property is priced relative to bonds as explained in chapter 2.

Table 6: Correlation Matrix

Variables	**SAPY Excess**	**ALSI Excess**	**ALBI Excess**	**Momentum**	**Size**	**Liquidity**	**Dividend Yield**	**Price to NAV**	**Earnings Yield**	**Dividend**	**Average Cost of**	**LTV**	**Interest Coverag**	**Inflation**	**Prime Interest**	**GDP**
SAPY Excess Returns	**1**															
ALSI Excess returns	**0.243**	**1**														
ALBI Excess returns	**0.645**	0.059	**1**													
Momentum	0.066	-0.053	-0.11	**1**												
Size	**-0.158**	0.099	-0.138	0.131	**1**											
Liquidity	**0.220**	-0.083	**0.199**	-0.132	0.012	**1**										
Dividend Yield	**0.162**	**-0.241**	0.044	-0.023	**-0.529**	0.084	**1**									
Price to NAV	**-0.422**	0.086	**-0.37**	0.106	**0.587**	**-0.193**	**-0.316**	**1**								
Earnings Yield	**0.275**	**-0.172**	**0.198**	**-0.154**	**-0.54**	**0.214**	**0.593**	**-0.433**	**1**							
Dividend Growth	-0.105	0.074	**-0.211**	**0.266**	0.13	**-0.309**	0.004	0.086	**-0.237**	**1**						
Average Cost of Debt	**0.266**	-0.104	**0.241**	0.037	**-0.288**	0.058	0.11	**-0.289**	**0.349**	**-0.212**	**1**					
LTV	-0.103	**-0.15**	-0.085	-0.015	0.123	0.086	0.043	**0.375**	-0.048	**-0.26**	-0.043	**1**				
Interest Coverage Ratio	-0.029	**0.198**	0.012	-0.049	**0.413**	-0.117	**-0.447**	**0.224**	**-0.251**	**0.145**	-0.026	**-0.301**	**1**			
Inflation	-0.084	**-0.253**	0.05	-0.106	-0.053	-0.01	0.063	-0.108	**0.144**	**-0.191**	0.104	-0.005	-0.061	**1**		
Prime Interest Rate	-0.048	**-0.209**	0.06	**-0.156**	-0.075	0.109	0.056	-0.116	0.126	-0.105	**0.198**	-0.047	-0.017	**0.559**	**1**	
GDP	0.085	0.131	0.022	-0.026	0.009	0.082	-0.035	-0.012	-0.062	-0.001	-0.023	0.074	-0.072	**-0.333**	0.042	**1**

Values in bold are different from 0 with a significance level alpha=0.05

Source: Author, XLSTAT

Performance of large market capitalisation property stocks tend to have a negative relationship with the SAPY Index as shown by the correlation of -0.158. In other words, the performance of smaller stocks tends to move in the same direction as the SAPY.

Performance of highly liquid property stocks tend to move in the same direction as the SAPY and the ALBI as shown by the correlations of 0.220 and 0.199, respectively.

Performance of property stocks with high dividend yields tend to move in the same direction as the SAPY and in the opposite direction to the ALSI and large capitalisation stocks, as shown by the correlations of 0.162, -0.241 and -0.529, respectively.

Performance of property stocks with high price to NAVs tend to move in the opposite direction to the SAPY, ALBI, highly liquid stocks and high dividend yielding stocks, as shown by the negative correlations of -0.422, -0.370, -0.193 and -0.316, respectively. Furthermore, there is a strong positive relationship between the performance of stocks with high price to NAVs and those with large market capitalisations as shown by the correlation of 0.587. This indicates that stocks with a high premium to NAV or low discount to NAV tend to have a negative relationship with the SAPY. This means that there is a long-term reversion to NAV or at least a mean price to NAV ratio implicit in listed property stocks.

Performance of property stocks with high earnings yields have a positive relationship with the SAPY, ALBI, highly liquid stocks and high dividend paying stocks, as shown by the correlations of 0.275, 0.189, 0.214 and 0.593, respectively. SA listed property companies are required to pay its investors a minimum of 75% of its taxable earnings (SA REIT Association, 2013 (a)). Therefore, the strong positive relationship between the performance of listed property stocks with high earnings yields and high dividend yields is expected. Property stocks with high earnings yields tend to move in the opposite direction to the ALSI, stocks with strong momentum, large capitalisation stocks and stocks with a high price to NAVs, as shown by the correlation coefficients of -0.172, -0.154, -0.540 and -0.433, respectively.

Performance of property stocks with high dividend growth rates tend to have a positive relationship with strong momentum stocks as shown by the correlation coefficient of 0.266. Furthermore, these stocks tend to move in the opposite direction to the ALBI, highly liquid stocks and stocks with high earning yields, as shown by the correlations of -0.211, -0.309 and -0.237.

Performance of property stocks with a high average cost of debt has a positive relationship with the SAPY, ALBI and stocks with high earnings yields, as shown by the correlations of 0.266, 0.241, and 0.349. Furthermore, stocks with a high average cost of debt tend to have a negative relationship with large capitalisation stocks (-0.288), stocks with high price to NAV ratios (-0.289) and stocks with high dividend growth rates (-0.212).

Performance of property stocks with high gearing tend to move in the same direction as stocks with high price to NAVs (0.375) and in the opposite direction to the ALSI (-0.150) and stocks with high dividend growth (-0.260).

Performance of property stocks with high interest coverage ratios tend to have a positive relationship with the ALSI, large capitalisation stocks, stocks with high price to NAVs and stocks with high dividend growth rates, as shown by correlations of 0.198, 0.413, 0.224 and 0.145, respectively. Furthermore, these stocks have a negative relationship with high dividend yielding stocks (-0.447), stocks with high earnings yields (-0.251) and high gearing (-0.301).

The inflation rate has a negative relationship with the performance of the ALSI and property stocks with high dividend growth rates, as shown by the correlations coefficients of -0.253 and -0.191, respectively. Inflation also has a positive relationship with high earnings yielding property stocks (0.144).

Finally, the prime interest rate tends to move in the opposite direction to the performance of the ALSI and stocks with high momentum, as shown by correlations of -0.209 and -0.156. An increase interest rates leads to an increase in the rate used to discount future cash flows to a present value. Which leads to a lower valuation and therefore lower equity prices. There is a positive relationship between interest rates and stocks with a high average cost of debt (0.198). There is a significant positive relationship between interest rates and inflation (0.495). This is expected because one of the monetary policy tools for controlling increasing inflation is an increase in interest rates.

5.3 Tests for Robustness

5.3.1 Multicollinearity

Multicollinearity refers to the relationship between the explanatory variables. Multicollinearity exists when the explanatory variables are highly correlated (Pallant, 2013). Serrano and Hoesli (2007) inspect for multicollinearity by examining the correlation coefficients between the independent variables. Using the correlation matrix above, it can be seen that the correlation coefficients range between -0.540 and +0.645 which shows limited amount of multicollinearity.

Another method used by statisticians is the variance-inflating factor (VIF), which shows the magnitude by which the variance of an explanatory variable is inflated by the presence of multicollinearity. The VIF is defined as follows:

$$VIF = \frac{1}{(1-r_{a,b}^2)} \qquad (18)$$

Where:

$r_{a,b}^2$: is the correlation coefficient between the independent variables X_a. and X_b.

The VIF value ranges from 1 to infinity, where value of 1 indicates no multicollinearity and the larger the value the greater the presence of multicollinearity (Gujarati, 2003). There seems to be no consensus on the maximum level of multicollinearity. The rule of thumb is that a VIF of greater than 10 indicates severe multicollinearity (O'brien, 2007).

Table 7: Test for Multicollinearity

Statistic	R^2	Tolerance	VIF	Present?
SAPY Excess Returns	59.2%	40.8%	2.4539	FALSE
ALSI Excess returns	29.1%	70.9%	1.4101	FALSE
ALBI Excess returns	48.2%	51.8%	1.9313	FALSE
Momentum	20.5%	79.5%	1.2582	FALSE
Size	59.3%	40.7%	2.4568	FALSE
Liquidity	24.6%	75.4%	1.3267	FALSE
Dividend Yield	53.4%	46.6%	2.1453	FALSE
Price to NAV	60.3%	39.7%	2.5179	FALSE
Earnings Yield	54.1%	45.9%	2.1779	FALSE
Dividend Growth	32.8%	67.2%	1.4886	FALSE
Average Cost of Debt	27.4%	72.6%	1.3774	FALSE
LTV	38.9%	61.1%	1.6363	FALSE
Interest Coverage Ratio	40.7%	59.3%	1.6857	FALSE
Inflation	48.9%	51.1%	1.9555	FALSE
Prime Interest Rate	42.6%	57.4%	1.7436	FALSE
GDP	22.2%	77.8%	1.2856	FALSE

Source: Author, XLSTAT

Table 7 above shows the tolerance (inverse of the VIF), the R^2 and the VIF for each variable. It can be seen that all the variables have a VIF of lower than 3. Therefore, none of the variables exhibit severe multicollinearity.

5.3.2 Stationarity

The VAR forecasting technique can only be used on stationary series. A series is considered stationary if its mean and variance are constant over time (Gujarati, 2003). The Augmented Dickey-Fuller (ADF) test is used to test for a unit root in the time series and as a result determining if the series is stationary. According to Serrano and Hoesli (2007) the ADF is a parametric test based on a autoregressive model of order p (i.e. AR(p)) such that the null hypothesis is that the series contains a unit root and is non-stationary and the alternative hypothesis is that the series is stationary.

The results of the ADF test is presented in table 8 below. To reject the null hypotheses that the series contains a unit root and is non-stationary at a 1%, 5% and 10% level the p-value should be less than or equal to 0.01, 0.05 and 0.1 respectively. As can be seen in table 8 below, all the series, except for the Prime Interest Rate time series, are stationary at a 5% significance level. The Prime Interest Rate series is stationary at the 10% significance level.

Table 8: Augmented Dickey-Fuller (ADF) Test Results.

Variable	Tau (Observed value)	Tau (Critical value)	p-value (one-tailed)
SAPY Excess Returns	-5.7475	-0.8563	< 0.0001
ALSI Excess returns	-6.0199	-0.8563	< 0.0001
ALBI Excess returns	-6.8463	-0.8563	< 0.0001
Momentum	-5.7943	-0.8563	< 0.0001
Size	-5.9537	-0.8563	< 0.0001
Liquidity	-6.4169	-0.8563	< 0.0001
Dividend Yield	-6.9284	-0.8563	< 0.0001
Price to NAV	-6.0437	-0.8563	< 0.0001
Earnings Yield	-6.4685	-0.8563	< 0.0001
Dividend Growth	-6.2275	-0.8563	< 0.0001
Average Cost of Debt	-4.3206	-0.8563	0.00313
LTV	-7.7141	-0.8563	< 0.0001
Interest Coverage Ratio	-5.7650	-0.8563	< 0.0001
Inflation	-4.4307	-0.8563	0.00223
Prime Interest Rate	-3.3073	-0.8563	0.06404
GDP	-3.4723	-0.8563	0.04266

Source: Author, XLSTAT

5.4 Analysis of Regression Results

Using a regression analysis of each model the study examines the potential factors behind the performance of the SAPY. It must be noted that these results for model 1, 2 and 3 are for a regression which takes into account the entire 20-year sample. Model 4 includes all variables therefore the sample used is from January 2000 to December 2015, because debt data was only available for that period. As explained earlier these relationships are dynamic and will change over time. Therefore, similar to Serrano and Hoesli (2007) all the regressions are rerun using a rolling 5 year period.

5.4.1 Model 1

Model 1 tests the Capital Asset Pricing Model of Sharpe (1964). The results of the regression analysis are in table 9 below:

Table 9: Model 1 Regression Results

Regression Statistics	
Multiple R	0.3374
R Square	0.1138
Adjusted R Square	0.1101
Standard Error	0.0443
Observations	240

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.0599	0.0599	30.5690	**0.0000**
Residual	238	0.4666	0.0020		
Total	239	0.5265			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	**0.0074**	0.0029	2.5659	0.0109	0.0017	0.0130
ALSI Excess Returns	**0.2864**	0.0518	5.5289	0.0000	0.1843	0.3884

Source: Author, MS Excel

The CAPM regression results in table 9 above show that the intercept is significantly different from zero. Therefore, the null hypothesis (1.1) is rejected and the test concludes that the CAPM does not fully explain of expected return of the SAPY. Furthermore, the intercept value is 0.007 on a monthly basis (or 0.084% per year), therefore the model suggests that 0.084% per year of additional alpha is being created. This result is in line with Najand *et al.* (2006) who find that US equity REITs produced on average 2.25% annualised excess returns (alpha) from June 1995 to December 2003.

The R^2 shows how well the data fits the model. The R^2 of 0.1138 shows us that the data does not fit the model too well. It tells us that only 11.38% of the SAPY's excess returns are explained by the excess return of the ALSI. The P-value of the F statistic in the ANOVA table is less than 0.001 therefore our regression analysis is significant.

A market beta value of 0.2863 is found. The p-value is approximately zero which means that the beta value is statistically significant at a 1% level. Therefore, the null hypothesis (1.2) is rejected and the test concludes that there is a statistically significant relationship between the market factor and returns of the SAPY. The market beta below one suggests that the SAPY is less volatile than the overall stock market and therefore relatively less risky. Our results support the findings of Liu and Mei (1992), Najand *et al.* (2006), Moyer (2008) and Bradfield *et al.* (2015) who find that REIT returns are less risky compared to equities.

5.4.2 Model 2

Model 2 tests the Fama and French (1993) 3-Factor Model. The results of the regression analysis are presented in table 10 below:

Table 10: Model 2 Regression Results

Regression Statistics	
Multiple R	0.4791
R Square	0.2295
Adjusted R Square	0.2197
Standard Error	0.0415
Observations	240

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0.1209	0.0403	23.4360	**0.0000**
Residual	236	0.4057	0.0017		
Total	239	0.5265			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	**0.0064**	0.0027	2.3836	0.0179	0.0011	0.0118
ALSI excess returns	**0.2853**	0.0486	5.8746	0.0000	0.1897	0.3810
Size	-0.0384	0.0606	-0.6333	0.5272	-0.1577	0.0810
Price to NAV	**-0.3565**	0.0645	-5.5245	0.0000	-0.4836	-0.2294

Source: Author, MS Excel

The Fama and French (1993) 3-Factor Model regression results in table 10 above show that the intercept is significantly different from zero. Therefore, the null hypothesis (2.1) is rejected and the test concludes that the Fama and French (1993) 3-Factor Model does not fully explain of expected return of the SAPY. Furthermore, the intercept value is 0.006 on a monthly basis (or 0.077% per year), therefore the model suggests that 0.077% per year of additional alpha is being created.

The R^2 of 0.2295 indicates that the three independent variables explain 22.95% of the monthly performance of the SAPY compared to the CAPM R^2 of 0.1138. This result is in line with findings of Fama and French (1993) which suggests that the 3-Factor Model is better than the CAPM in explaining SAPY excess returns. The P-value (0.0000) of the F statistic is less than 1% therefore the regression is significant.

The stock market beta or market risk is approximately 0.2853 with a p-value of approximately zero which means that the beta value is statistically significant at a 1% level. Therefore, the null hypothesis (2.2) is rejected and the test concludes that there is a statistically significant relationship between the market factor and returns of the SAPY. The positive market beta means that even when considering the size and value factors, the SAPY is less volatile than the market.

The results show that the size slope coefficient is negative (-0.038) which may indicate the presence of the small size effect. However, its P-value indicates that the coefficient is not statistically significant. Therefore, the test fails to reject the null hypothesis (2.2) implying that there is no statistically significant relationship between the size factor and the expected return of the SAPY Index, therefore the size effect does not exist. Banz (1981) and Hamelink and Hoesli (2004) find a statistically significant negative relationship between the size of a firm and its expected return. On the contrary Serrano and Hoesli (2007) find a positive relationship between size and US equity REIT returns.

Fama and French (1993) use the book to market ratio in their analysis and find a significant positive relationship. The inverse of that ratio which is the price to book value (NAV) is used in our analysis and find evidence of a significant negative relationship because of the statistically significant slope coefficient of -0.3565. Therefore, the null hypothesis (2.2) is rejected and the test concludes that the value effect does exist. This results is in line with Fama and French (1993), Muller and Ward (2013) and Shapiro (2016) who find that value is positively related to excess returns.

5.4.3 Model 3

Model 3 tests the SAPY excess returns against the excess returns of the ALSI and the ALBI (CAPM plus Bond Factor Model). The results are presented in table 11 below.

Table 11: Model 3 Regression Results

Regression Statistics	
Multiple R	0.6011
R Square	0.3613
Adjusted R Square	0.3559
Standard Error	0.0377
Observations	240

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.1902	0.0951	67.0247	**0.0000**
Residual	237	0.3363	0.0014		
Total	239	0.5265			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	**0.0064**	0.0024	2.6103	0.0096	0.0016	0.0112
ALSI excess returns	**0.1413**	0.0466	3.0330	0.0027	0.0495	0.2331
ALBI excess returns	**0.9717**	0.1014	9.5821	0.0000	0.7719	1.1714

Source: Author, MS Excel

The CAPM plus Bond Factor Model regression results in table 11 above show that the intercept is significantly different from zero. Therefore, the null hypothesis (3.1) is rejected and the test concludes that the CAPM plus Bond Factor Model does not fully explain of expected return of the SAPY. Furthermore, the intercept value is 0.006 on a monthly basis (or 0.077% per year), therefore the model suggests that 0.077% per year of additional alpha is being created.

The R^2 for model 3 indicates that the ALSI and ALBI excess returns explains approximately 36.1% of the SAPY excess returns. The regression is significant as indicated by the P-value of the F statistics which is below the 1% level. The market beta is 0.1413 and statistically significant at a

1% level. Therefore, the null hypothesis (3.2) is rejected and the test concludes that there is a statistically significant relationship between the market factor and returns of the SAPY. However, with the addition of ALBI excess returns to the CAPM, the results show that the stock market beta drops significantly to from 0.2864 to 0.1413.

The slope coefficient of the ALBI excess returns is strongly significant and has a value of 0.9717. Therefore, the null hypothesis (3.2) is rejected and the test concludes that there is a statistically significant relationship between the bond factor and returns of the SAPY. Furthermore, the relative high bond coefficient suggests that the SAPY performed more like bonds than equity over the sample period. This result is in line with Motara (2013), Strydom (2014), Bradfield *et al.* (2015), Bezuidenhout *et al.* (2016) and Jankelowitz *et al.* (2016 (a)) who argue that the SAPY has a positive relationship with bonds. On the contrary, Liu and Mei (1992) find that US EREITs do not resemble bonds and that bonds do not form part of the hybrid nature of EREITs.

5.4.4 Model 4

Model 4 tests the SAPY excess returns against all the variables. Model 4 is tested using data from January 2000 to December 2015 because LTV and Interest Coverage Ratio data is only available from January 2000. The regression results are presented in table 12 below.

Table 12: Model 4 Regression Results

Regression Statistics	
Multiple R	0.7697
R Square	0.5925
Adjusted R Square	0.5577
Standard Error	0.0296
Observations	192

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15	0.2246	0.0150	17.0586	**0.0000**
Residual	176	0.1545	0.0009		
Total	191	0.3791			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.0168	0.0107	1.5666	0.1190	-0.0044	0.0380
ALSI Excess returns	**0.2521**	0.0478	5.2750	0.0000	0.1578	0.3464
ALBI Excess returns	**1.1203**	0.1192	9.3958	0.0000	0.8850	1.3556
Momentum	**0.2007**	0.0649	3.0929	0.0023	0.0726	0.3288
Size	**0.1931**	0.0928	2.0802	0.0390	0.0099	0.3763
Liquidity	0.0960	0.0774	1.2406	0.2164	-0.0567	0.2487
Dividend Yield	**0.2000**	0.0950	2.1038	0.0368	0.0124	0.3875
Price to NAV	**-0.3135**	0.0816	-3.8403	0.0002	-0.4746	-0.1524
Earnings Yield	0.1376	0.0944	1.4570	0.1469	-0.0488	0.3239
Dividend Growth	0.0128	0.0708	0.1803	0.8571	-0.1269	0.1524
Average Cost of Debt	0.1221	0.0750	1.6278	0.1054	-0.0259	0.2702
LTV	0.0972	0.0759	1.2798	0.2023	-0.0527	0.2470
Interest Coverage Ratio	0.0402	0.0642	0.6254	0.5325	-0.0866	0.1670
Inflation	-0.0707	0.1132	-0.6249	0.5328	-0.2941	0.1526
Prime Interest Rate	-0.0607	0.1095	-0.5540	0.5803	-0.2768	0.1555
GDP	0.0532	0.0993	0.5356	0.5929	-0.1427	0.2491

Source: Author, MS Excel

The All Factor Model regression results in table 12 above show that the intercept is not significantly different from zero. Therefore, the test fails to reject the null hypothesis (4.1) and concludes that the All Factor Model fully explains the pattern of expected returns of the SAPY. From the four models tested the All Factor Model is the only model with an intercept that is not statistically different from zero.

The R^2 for the model is 0.5925 which means that the independent factors explain approximately 59.3% of the SAPY excess returns. This is the highest R^2 amongst all our models.

The ALSI beta is 0.252 and the ALBI beta is 1.120, both statistically significant at a 1% level. Therefore, the null hypotheses (4.2) for the ALSI and ALBI beta's are rejected and the test concludes that there is a statistically significant relationship between both the bond and market factors and returns of the SAPY. The higher bond factor beta is evidence that the listed property sector is more bond like than equity like over the January 2000 to December 2015 sample period.

The momentum factor beta is +0.200 and is statistically significant at a 1% level. Therefore, the null hypothesis (4.2) for the momentum factor is rejected and the study finds evidence in support of the momentum effect existing for South African listed property stocks. This result is similar to Chui *et al.* (2003), Jegadeesh and Titman (1993) and Muller and Ward (2013) who find a positive relationship between returns and the momentum effect.

The size beta is found to be positive and statistically significant. Therefore, the null hypothesis (4.2) for the size factor is rejected. The size beta of 0.193 means that there is a positive relationship between size and expected returns (i.e. on average larger stocks perform better than their smaller peers). This finding is in agreement with Serrano and Hoesli (2007) who find a positive relationship between size and US equity. However, it is in contrast to previous research such as Banz (1981), Fama and French (1993); Glascock *et al.* (2000) and Serrano and Hoesli (2007), who find that small capitalisation property stocks have on average higher returns. Furthermore, this is the opposite sign to the correlation coefficient between SAPY and the size variable described in section 5.1 above. The difference in the sign on the size factor could be due to the OLS regression technique trying to fit the best line using all the factors. Therefore, the sign changed because of the interaction with other independent variables.

The beta of the dividend yield factor (+0.200) is positive and statistically significant. Therefore, the null hypothesis (4.2) for the dividend yield factor is rejected implying that listed property stocks with higher dividend yields have on average higher returns. Our evidence supports findings by Muller and Ward (2013), Chiang (2015) and Shapiro (2016) who find a clear positive relationship between high dividend yield stocks and returns.

The price to NAV factor is negative (-0.314) and strongly significant. Therefore, the null hypothesis (4.2) for the price to NAV factor is rejected implying that stocks which trade at a high premium to NAV or low discount to NAV have on average lower returns. Therefore, South African listed property tends to revert to a long term mean net asset value. This result is similar to Chan *et al.* (2003), Muller and Ward (2013) and Shapiro (2016) who find a linear performance ranking from lowest price to NAV to highest price to NAV.

The remaining variables are not significant at a 5% level; therefore, the study fails to reject null hypothesis (4.2) for the liquidity, earnings yield, dividend growth, average cost of debt, loan to value ratio, interest coverage ratio, inflation rate, prime interest rate and gross domestic product factors and concludes that these factors do not have a statistically significant relationship with the expected return of the SAPY Index.

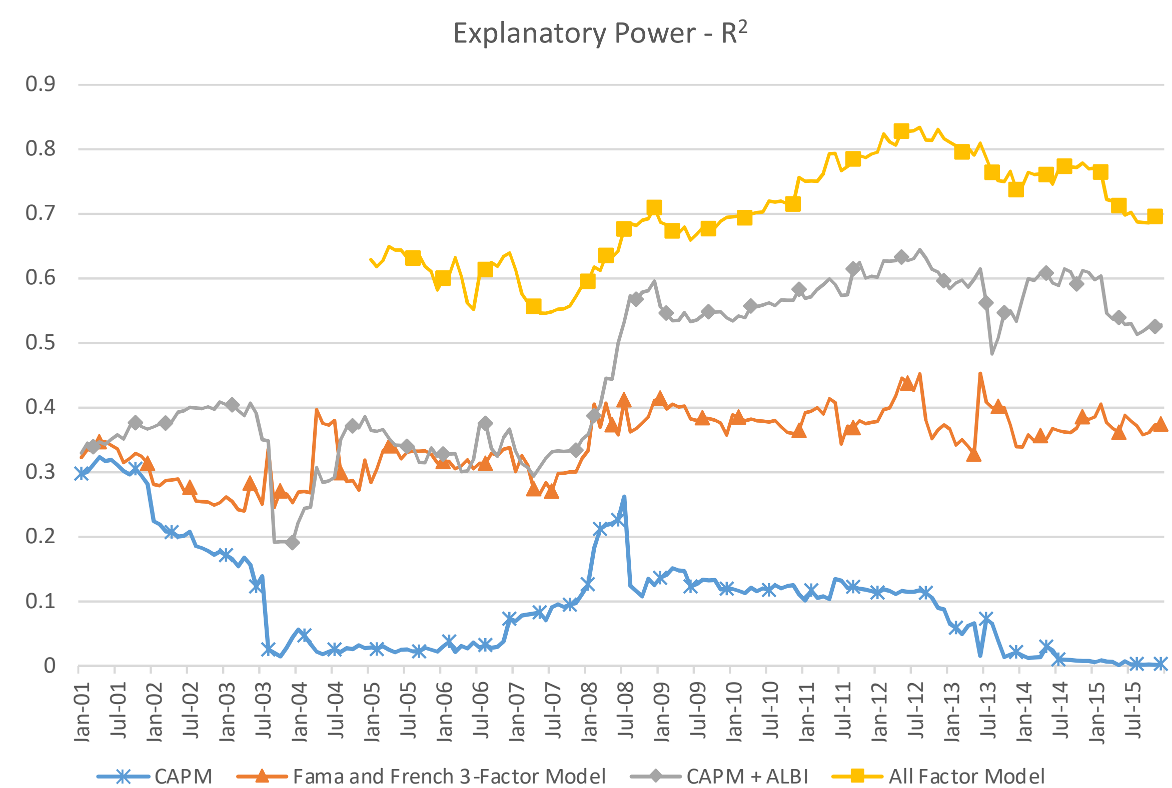
5.5 Rolling regression analysis

To examine the changes in the betas of each variable over time a 5-year rolling regression of each model was conducted.

5.5.1 Explanatory Power

Figure 7 below plots the coefficient of determination or R^2 for the 5-year rolling regressions for each model. The graph shows that the Fama and French 3-Factor model outperforms the CAPM over the entire period. Therefore, this is further evidence that the Fama and French 3-Factor model does a better job than the CAPM in explaining SAPY excess returns. Furthermore, the results show that model 4 which contains all the variables is superior to the other models in explaining SAPY excess returns.

Figure 7: Explanatory power of each model

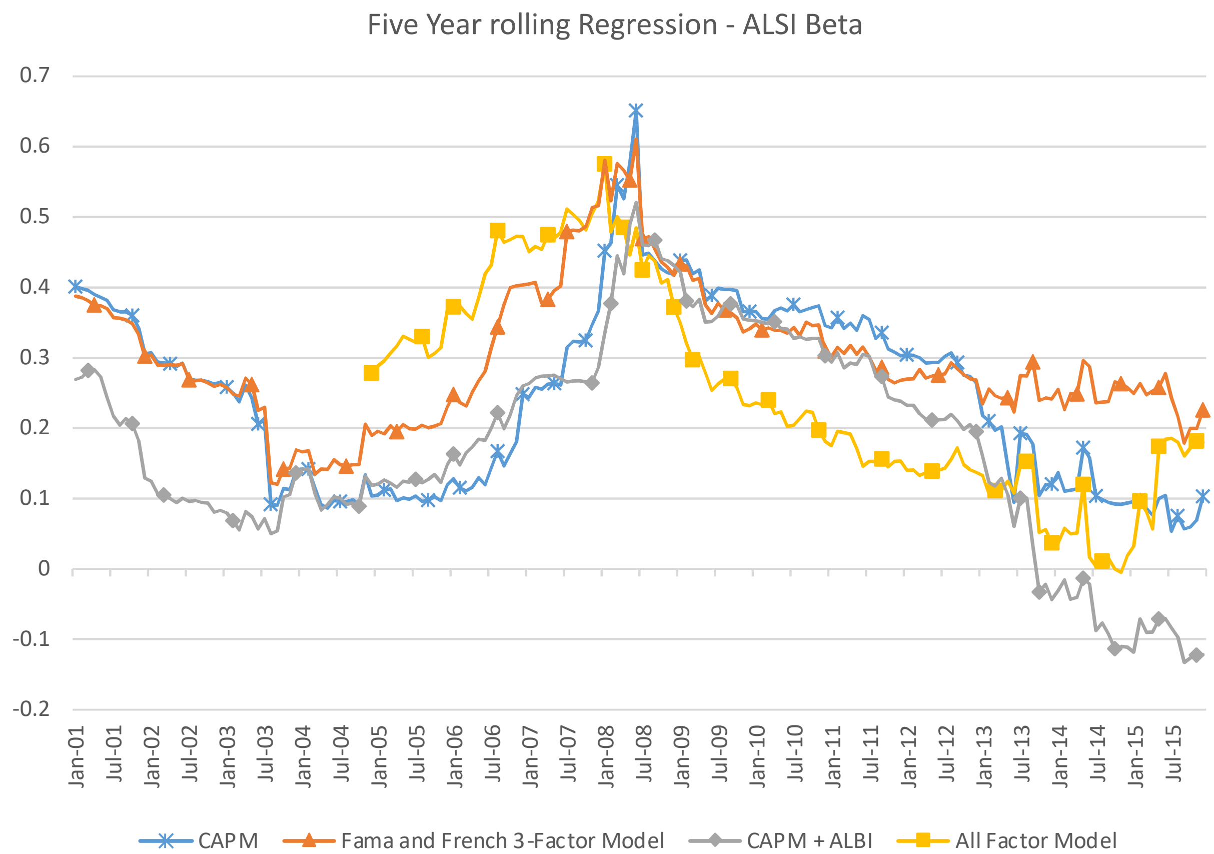


Source: Author, MS Excel

5.5.2 ALSI Excess Return Beta

Figure 8 below illustrates how the market risk changes over time for the different models.

Figure 8: Five year rolling ALSI beta coefficient



Source: Author, MS Excel

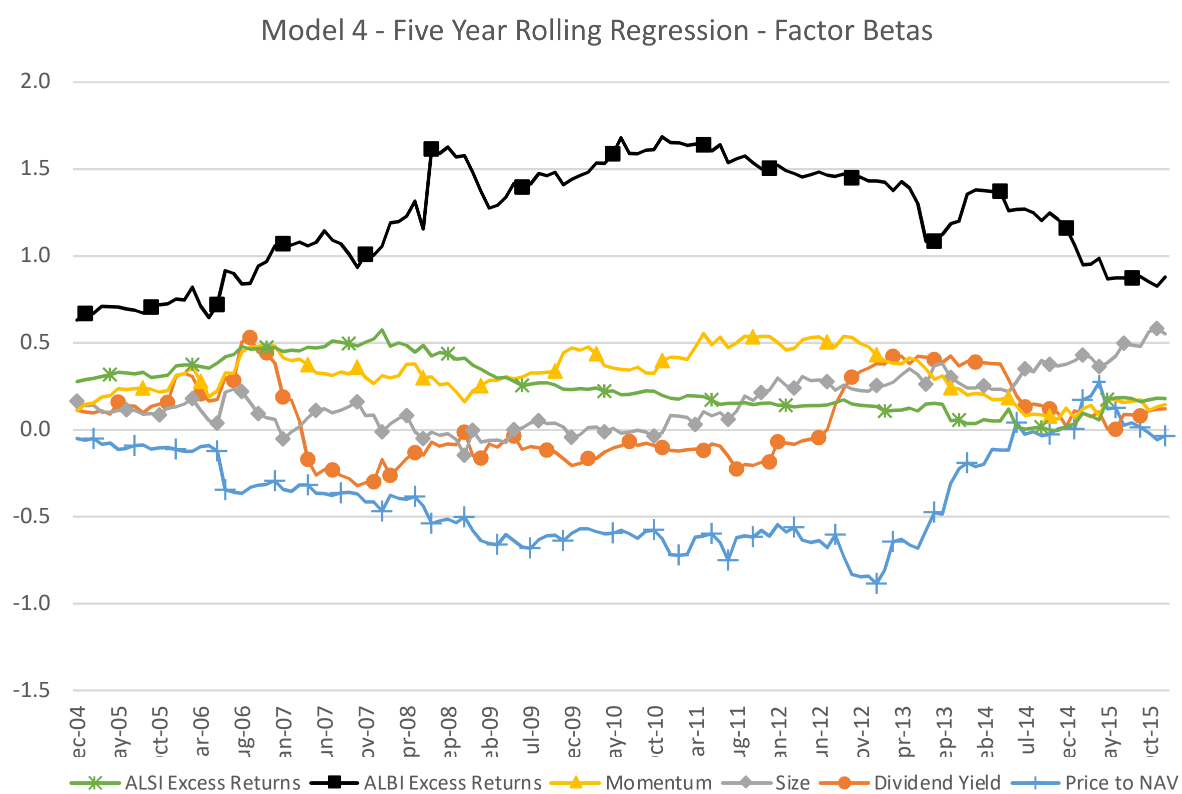
As you can see from the figure above the market risk of the SAPY increased significantly before and during the Global Financial Crises (GFC started in 2007 and ended in 2009) and peaked in June 2008. After the GFC an overall downward trend is observed.

Similar to Serrano and Hoesli (2007) the study finds that the addition of the size and price to NAV factors to the CAPM, does not alter the market risk significantly. The stock market betas of the CAPM and Fama and French (1993) 3-Factor models have a correlation of 81.3%. The graph shows that the models started to follow relatively independent paths from the start of 2013. The reasoning behind the possible structural break could be an area of further investigation.

5.5.3 Five Year Rolling Regression of Model 4

Figure 9 below graphs only the statistically significant factor coefficients for model 4 over time. As expected, the ALBI factor beta dominates throughout the sample period. The ALSI beta remains below the ALBI beta for the entire sample period, again showing that listed property behaves more like bonds than equity. One should take note that at around halfway through the sample (October 2010) the ALBI beta begins to trend downwards. Which suggests that listed property started behaving less like bonds over the second part of the sample period. The ALSI beta remains low for most of the sample size providing evidence that listed property has consistently low market risk and therefore can be used to diversify a portfolio. Similar to Serrano and Hoesli (2007) we find a downward trend in the market beta

Figure 9: Five year rolling regression: significant factor beta values



Source: Author, MS Excel

The momentum beta is relatively stable ranging from 0.1 to 0.5 for majority of the time period. However, after October 2012, a downward trend in the momentum beta is found. This suggests that high momentum stocks began to have less of an effect on average returns.

The size beta was approximately zero pre-2010 but began to trend upwards post-2010 reaching a peak of 0.583 in November 2015. This is evidence that after 2010 larger listed property companies began to perform better than their smaller peers with the relationship strengthening over time.

Even though the overall dividend yield beta is positive, the results show that the rolling beta was negative for 62 months from April 2007 to June 2012. This means that stocks with lower dividend yields (and high capital growth expectations) outperformed over that specific time period.

The negative relationship between excess returns and the price to NAV factor strengthened from December 2004 to January 2013. However, thereafter the price to NAV beta increased significantly towards zero, which suggests that price to NAV factor began to have a reduced effect on average returns. This could be a result of investors ignoring price to NAV data when making investment decisions. Examples of this are stocks such as New Europe Property Investments (NEP) and Rockcastle Global Real Estate (ROC) which outperformed the market even though they trade at significant premiums to NAV.

5.6 Vector autoregression (VAR) Results

Table 13 below presents the forecasting accuracies for each model. The results show that model 4 (All Factor Model) has the lowest ME, RMSE, MAE and Theil's U^2. In addition, model 4 has the highest directional accuracy. This is evidence that model 4 is the most optimal model.

Table 13: Forecasting Accuracies

Forecasting Accuracies	Mean Error (ME)	Root Mean Squared Error (RMSE)	Mean Absolute Error (MAE)	Directional Accuracy	Theil's U^2 inequality coefficient
Model 1	-0.0018	0.0367	0.0273	0.6806	0.4907
Model 2	-0.0011	0.0366	0.0271	0.6806	0.4882
Model 3	-0.0037	0.0265	0.0203	0.7500	0.2569
Model 4	**0.0002**	**0.0264**	**0.0207**	**0.7917**	**0.2537**

Source: Author, MS Excel

5.7 Trading Strategy

This section of the research compares the performance of an active trading strategy to a passive buy and hold strategy. The trading strategy is tested with the out of sample data set from January 2010 to December 2015. The results show that a passive investment in the SAPY would have produced a total excess return of 203% over a five-year period between January 2010 and December 2015. An active strategy based on model 1, 2 and 3 produced total excess returns of 187%, 197% and 162%, respectively. Therefore, these strategies would have underperformed the passive buy and hold strategy. However, the active strategy based on model 4 would have grown by 205% beating the passive strategy by 1.2%.

Table 14: Out of sample returns data

	Buy & Hold	**Active Strategy**	**% Difference**
Model 1	203%	187.3%	-7.7%
Model 2	203%	196.8%	-3.1%
Model 3	203%	162.2%	-20.1%
Model 4	**203%**	**205.4%**	**1.2%**

Source: Author, MS Excel

Note that the active strategies tested above do not take into account transaction costs. Therefore, with transaction costs of approximately 48bps for a round trip (buy and sell) even model 4 would underperform the passive strategy. Portfolios are rebalanced every quarter therefore after only three quarters all the alpha would be eroded. Nelling and Gyourko (1998), Ling *et al.* (2000) and Brooks and Tsolacos (2001) find similar results. They find that when transaction costs are taken into account the excess returns of the active strategies disappear. According to Brooks and Tsolacos (2001) a trading rule that can produce excess returns net of costs is evidence of market information inefficiency

As explained in section 4.7.3 the study uses the paired two sample for means t-Test to determine if the out-of-sample returns generated by the active models are significantly different from the actual returns achieved by the passive investment strategy.

Table 15: t-Test: Paired Two Sample for Means

	SAPY Excess Returns	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Mean	1.06%	0.88%	0.95%	0.69%	1.08%
Variance	0.14%	0.01%	0.01%	0.03%	0.14%
P(T<=t) two-tail		**0.6867**	**0.8062**	**0.2448**	**0.9522**
t Critical two-tail		1.9939	1.9939	1.9939	1.9939

Source: Author, MS Excel

Hypothesis 5 tests the following:

> **H_0:** Returns from an active trading strategy are not different from a passive buy and hold strategy for South African listed property.
>
> **H_1:** Returns from an active trading strategy are different from a passive buy and hold strategy for South African listed property.

The mean differences coefficient for all the active models is not significant (*$p>0.05$*) as presented in Table 15 in section 5.7 and therefore the null hypothesis, **H_0**, can be accepted. Therefore, the test concludes that there is no significant difference between returns generated by the active model and the actual returns of the passive investment.

The study finds that there is no statistically significant difference between active and passive returns. In addition, none of the models tested can produce excess returns net of trading costs, therefore, it is concluded that the South African listed property market is efficient and one would not find it profitable to search for arbitrage opportunities.

Chapter 6: Research Findings and Conclusions

6.1 Introduction

This chapter presents the findings, conclusions and suggestions for further research on the topic. This study investigates the determinants and predictability of listed property returns in South Africa based on the framework developed by Eugene Fama and Kenneth French.

The research aim is to determine what factors influence South African listed property returns and if these returns can be consistently forecasted and used to develop an active trading strategy capable of outperforming the market.

In Chapter 1 the problem statement was:

> By determining which factors could influence South African listed property returns, one could develop an active trading strategy capable of earning greater than market returns.

The research questions to be addressed may be stated as:

> What macro-economic, market and firm specific factors can consistently explain the return characteristics of South African listed property?
>
> Could an active trading strategy based on the predictability of returns generate greater than market returns?

6.2 The Findings and Conclusions Relating to the Research Questions

What macro-economic, market and firm specific factors can consistently explain the return characteristics of South African listed property?

To answer the first research question four asset pricing models were tested, including the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964) and Lintner (1965), the Fama and French

(1993) 3-Factor model, a model which adds the South African Bond Index to the CAPM and finally a model which includes macroeconomic, market and firm specific factors.

The main findings are as follows:

- The CAPM, Fama and French (1993) 3-Factor model and the CAPM plus Bond Factor model do not fully explain the patterns of expected return of the South African Listed Property Index. However, the evidence suggest that the All Factor model is able to fully capture the pattern of expected return of the South African Listed Property Index.
- The South African Listed Property Index has a relatively low market risk beta. Therefore, the SAPY is less volatile than the overall stock market and therefore relatively less risky. South African listed property is more bond like than it is equity like as evidence by a much higher ALBI excess returns beta compared to the stock market beta. These findings are in agreement with Liu and Mei (1992), Najand *et al.* (2006), Moyer (2008) and Bradfield *et al.* (2015) who find that REIT returns are less risky compared to equities.
- The CAPM (model 1) produces a R^2 of 0.1138 compared to the Fama and French (1993) 3-Factor Model (model 2) which produces a R^2 of 0.2295. The higher R^2 suggests that the Fama and French (1993) 3-Factor Model is better than the CAPM in explaining SAPY excess returns which is in line with the findings of Fama and French (1992; 1993; 2004).
- The study finds evidence in support of the momentum effect existing for South African listed property stocks. The momentum factor beta is +0.200 and is statistically significant at a 1% level. Therefore, higher momentum stocks have on average higher returns. This result is similar to Chui *et al.* (2003), Jegadeesh and Titman (1993) and Muller and Ward (2013) who find a positive relationship between returns and the momentum effect.
- Our evidence suggests that there is a positive relationship between the size of a listed property company and returns. The statistically significant positive size beta of 0.193 means that on average larger stocks perform better than their smaller peers. This finding is in agreement with Serrano and Hoesli (2007) who find a positive relationship between size and US equity REIT returns. However, the finding is in contrast to prior studies such Banz (1981), Fama and French (1993); Glascock *et al.* (2000) and Hamelink and Hoesli

(2004) who find that smaller companies perform better than their larger peers (small size effect).

- The dividend yield factor is positive (+0.200) and statistically significant which suggests that listed property stocks with higher dividend yields have on average higher returns. Our evidence supports findings by Muller and Ward (2013), Chiang (2015) and Shapiro (2016) who find a clear positive relationship between high dividend yield stocks and returns.
- There is a significant negative relationship between the price to NAV factor and excess returns (-0.314). This is evidence that stocks which trade at a high premium to NAV or low discount to NAV have on average lower returns. Therefore, South African listed property tends to revert to a long term mean net asset value. This result is similar to Chan *et al.* (2003), Muller and Ward (2013) and Shapiro (2016) who find a linear performance ranking from lowest price to NAV to highest price to NAV.
- Table 16 below presents a summary of the statistically significant relationships between the various tested determinants and the excess return of the South African Listed Property Index.

Table 16: Summary of Statistically Significant Relationships between the Determinants and SAPY Excess Returns

	Model 1	*Model 2*	*Model 3*	*Model 4*
Determinants	*CAPM*	*Fama and French (1993) 3-Factor Model*	*CAPM plus Bond Factor Model*	*All Factor Model*
ALSI Excess returns	**Positive**	**Positive**	**Positive**	**Positive**
ALBI Excess returns			**Positive**	**Positive**
Momentum				**Positive**
Size				**Positive**
Liquidity				
Dividend Yield				**Positive**
Price to NAV		**Negative**		**Negative**
Earnings Yield				
Dividend Growth				
Average Cost of Debt				
LTV				
Interest Coverage Ratio				
Inflation				
Prime Interest Rate				
GDP				

Source: Author, MS Excel

By analysing the 5-year rolling regressions the study finds the following results:

- The R^2 for the 5-year rolling regressions for each model confirm our initial findings that the Fama and French 3-Factor model outperforms the CAPM over the entire sample period. Furthermore, we find that the All Factor Model (model 4) is superior to the other models in explaining SAPY excess returns.
- The results suggest that the stock market beta does not change significantly when additional factors were added. This is similar to findings of Serrano and Hoesli (2007) who show that the addition of the size and price to NAV factors to the CAPM does not alter the market risk significantly.

- By analysing the 5-year rolling regression of the All Factor Model we find that there is a downward trend in the momentum beta after October 2012. This suggests that high momentum stocks began to have less of an effect on average returns.
- We find that the size beta was approximately zero pre-2010 but began to trend upwards post-2010 reaching a peak of 0.583 in November 2015. This is evidence that after 2010 larger listed property companies began to performed better than their smaller peers with the relationship strengthening over time. This confirms our earlier finding of a positive relationship between size and returns which is in contrast to previous research by Banz (1981), Fama and French (1993); Glascock *et al.* (2000) and Hamelink and Hoesli (2004) who find evidence of the small size effect.
- The study finds that the rolling dividend yield beta was negative for 62 months from April 2007 to June 2012. This means that stocks with lower dividend yields (and high capital growth expectations) outperformed over that specific time period.
- The negative relationship between returns and the price to NAV factor strengthened from December 2004 to January 2013. However, thereafter the price to NAV beta increased significantly towards zero, which suggests that price to NAV factor began to have a reduced effect on average returns. This could be a result of investors ignoring price to NAV data when making investment decisions.

To test the predictive power of each of the models the study forecasts each model using out-of-sample data. The results are as follows:

- The All Factor Model has the lowest mean error, root mean squared error, mean absolute error and Theil's U^2 inequality coefficient. In addition, model 4 has the highest directional accuracy.
- This is evidence that model 4 is the most optimal model.

The second part of the study investigates the following research question:

Could an active trading strategy based on the predictability of returns generate greater than market returns?

The study tests a trading strategy based on each model with the out of sample data set from January 2010 to December 2015. The evidence suggests that a passive investment in the SAPY would have produced a total excess return of 203% over the five-year period. An active strategy based on model 1, 2 and 3 produced total excess returns of 187%, 197% and 162%, respectively. Therefore, these strategies would have underperformed the passive buy and hold strategy. However, the active strategy based on model 4 would have grown by 205% beating the passive strategy by 1.2%. However, our analysis ignores trading costs which is expected to be around 48bps for a round trip (buy and sell). Portfolios are rebalanced every quarter, therefore, after only three quarters all the alpha would be eroded. Similar to Nelling and Gyourko (1998), Ling *et al.* (2000) and Brooks and Tsolacos (2001) the study finds that once transaction costs are included, none of the active strategies can outperform the passive strategy. Furthermore, the study finds that there is no statistically significant difference between active and passive returns. Therefore, in conclusion, the South African listed property sector is found to be efficient and profitable arbitrage opportunities should not exist.

The results of this study have implications for both investors and academics. For investors, the predictability of listed property returns affects their asset allocation and hedging decisions. Furthermore, the results of this study show that there is no difference between active and passive listed property investment returns. On the other hand, academics are more interested in the understanding and implications for the theory of market efficiency. The study finds that active trading of listed property stocks does not lead to superior returns and therefore the South African listed property market is found to be efficient.

6.3 Achievement of the Research Objectives

The research objectives were to:

a) Analyse the impact of a wide range of macro-economic, market and firm specific factors on listed property returns in South Africa.
b) Develop a multifactor model to forecast listed property returns in South Africa.
c) Develop an active trading strategy that would outperform a passive buy and hold strategy and therefore earn greater than market returns.

The research has addressed the first objective by means of a literature review in Chapter 3 and a quantitative analysis of secondary data in Chapter 5. Chapter 3 provides a discussion of various factors that previous literature suggests have a relationship with listed property returns. In Chapter 5, the determinants of SA listed property returns were determined by performing a regression analyses of four different models. The second and third research objectives were addressed in Chapter 4 and Chapter 5. The second objective is discussed in Chapter 4 and achieved in Chapter 5 by adopting the vector autoregressive (VAR) forecasting technique to develop four SA listed property return forecasting models. The third objective was achieved since each model was tested using an out of sample data set and the results were compared to a passive buy and hold strategy over the same period.

6.4 Recommendations for Further Research

The study investigated the determinants and predictability of listed property returns in South Africa. The SA listed property sector is a relatively new sector with many companies only being listed on the JSE for a few years. In addition, the SA listed property index or SAPY was used as the main proxy for the SA listed property sector. However, as mentioned in Chapter 2, the SAPY has evolved in its relatively short existence, specifically the conversion to the REIT structure and the increase in off-shore exposure. Therefore, the accuracy of the models could be improved with a longer more consistent data set.

The study was limited to the most common determinants found in the literature. However, the models could be improved by adding property specific factors such as vacancy, sector specialisation and location of property.

Lastly, the study was limited to the VAR forecasting method. It is suggested that the predictive potential of each model be tested using other forecasting methods such as time varying coefficient regressions and neural networks models.

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Annexure 1 - Factor Definitions

Variable	Definition
r_{sapy}	Total excess returns for month t of the SAPY index (i.e. SAPY return – risk-free return
r_{all}	total excess returns for month t of the All Share Index (i.e. All Share Index return – risk-free return)
r_{albi}	total excess returns for month t of the All Bond Index (i.e. All Bond Index return – risk-free return)
$Inflation$	Stats SA CPI year on year % change
$Int\ Rate$	SARB Prime Interest rate
GDP	SARB Quarter-on-quarter, seasonally adjusted and annualised growth rate of real GDP at market prices
$Momntm$	Total Return over the previous 12 Months
$Size$	Monthly returns of the large market capitalisation portfolio minus returns of the small market capitalisation portfolio.
$Liquid$	Monthly returns of a very liquid portfolio minus returns of the least liquid portfolio.
$Div\ Yld$	Monthly returns of the high dividend yielding portfolio minus returns of the lowest dividend yielding portfolio
$PNAV$	Monthly returns of the high price to NAV portfolio minus returns of the low price to NAV portfolio
$Earn\ Yld$	Monthly returns of the high earnings yielding portfolio minus returns of the lowest earnings yielding portfolio
$Div\ Grw$	Monthly returns of the high dividend growth portfolio minus returns of the lowest dividend growth portfolio
$Cost\ Debt$	Monthly returns of the high cost of debt portfolio minus returns of the lowest cost of debt portfolio
LTV	Monthly returns of the highly-geared portfolio minus returns of the lowest geared portfolio

$Int\ Cov$	Monthly returns of the high interest coverage portfolio minus returns of the low interest coverage portfolio.

Annexure 2 - Akaike's (AIC) and Schwarz's Bayesian (SBC) Information Criteria

Model 1

Number in Model	Adjusted R-Square	R-Square	AIC	SBC	SSE	Variables in Model
1	0.1068	0.111	-1298.75	-1292.05	0.42467	ALSI_ExcessReturns
1	-0.0034	0.0014	-1274.32	-1267.62	0.47706	ALSI_ExcessReturns_lag12
1	-0.0038	0.001	-1274.24	-1267.54	0.47724	ALSI_ExcessReturns_lag2
1	-0.0045	0.0003	-1274.1	-1267.41	0.47755	ALSI_ExcessReturns_lag3
1	-0.0047	0.0001	-1274.06	-1267.36	0.47765	ALSI_ExcessReturns_lag6
1	-0.0048	0	-1274.04	-1267.35	0.47769	ALSI_ExcessReturns_lag1

Model 2

Number in Model	Adjusted R-Square	R-Square	AIC	SBC	SSE	Variables in Model
3	0.2164	0.2276	-1324.27	-1310.89	0.36896	ALSI_ExcessReturns PricetoNAV Size_lag12
1	0.1068	0.111	-1298.75	-1292.05	0.42467	ALSI_ExcessReturns
1	0.1043	0.1086	-1298.17	-1291.47	0.42584	PricetoNAV
2	0.1025	0.1111	-1296.76	-1286.72	0.42463	PricetoNAV Size_lag12
2	0.1025	0.1111	-1296.76	-1286.72	0.42464	ALSI_ExcessReturns Size_lag12
1	-0.0048	0	-1274.03	-1267.34	0.4777	Size_lag12

Model 3

Number in Model	Adjusted R-Square	R-Square	AIC	SBC	SSE	Variables in Model
2	0.3478	0.3537	-1441.81	-1431.6	0.32661	ALBI_ExcessReturns ALSI_ExcessReturns
1	0.3266	0.3296	-1435.69	-1428.89	0.33878	ALBI_ExcessReturns
1	0.1081	0.1121	-1373.31	-1366.51	0.44869	ALSI_ExcessReturns

Model 4

Number in Model	Adjusted R-Square	R-Square	AIC	SBC	SSE	Variables in Model
7	0.581	0.5981	-1203.14	-1177.96	0.14363	ALBI_ExcessReturns PricetoNAV ALSI_ExcessReturns Momentum EarningYield LTV_lag2 DividendGrowth_lag6