

**COMMERCIAL PROPERTY:
A REQUIRED RATE OF RETURN INVESTIGATION**

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**Dissertation submitted in partial fulfilment of the requirements for the degree
Master in Business Administration at the Northwest University**

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POTCHEFSTROOM CAMPUS
2005**

ABSTRACT

When faced with an investment opportunity in commercial real estate, the investor requires knowledge of the discount rate since it can be used to convert expected future cash flows from the property in today's terms and in doing so, place a value on the property. The so-called required rate of return would be the appropriate conversion rate since it compensates the investor for risk and, if attainable, will induce the investor to invest. An inaccurate assessment of the discount rate could, depending on the direction of the error, lead to a potential over or under estimation of the property value.

A number of single or multiple variable frameworks for required return have been derived by other researchers for the US, UK and EU property markets. Each of the variables encountered in these frameworks acts as a proxy for some aspect of systematic risk associated with the investment. However, locally, such models are either not extensively published or well described and are limited to single explanatory variables. Some professionals prefer to avoid frameworks and simply divert to qualitative, gut-feel and experienced based considerations in order to derive at required return rate.

This dissertation addressed the possible local need for an explanatory framework of required return on commercial property. The scope of work entailed: (i) a review of the literature to establish the theoretical determinants of return and (ii) an empirical study to test a short-list of parameters for Retail, Offices and Industrial sites in Cape Town, Pretoria, Bloemfontein and Durban, respectively.

Three categories of explanatory variables were identified: (i) Capital market variables and alternative investment opportunities in the form of stocks on the JSE, (ii) economic activity indicators and (iii) property market fundamental parameters. The empirical study entailed a three-phase methodology, which included the following steps: (i) data sampling and processing, (ii) screening variables through the simple regression and correlation coefficients and (iii) multiple regression complemented by statistical

significance testing. Between 69% and 98.2 % ($\alpha=0.1$) of the variation in returns could be explained in terms of the variation by the explanatory variables that passed the rigorous screening process. The relative good results are likely to be related to the higher explanatory power of the multi-factor approach. The remaining unexplained portion of return can potentially be decreased by using larger samples and pursuing some of the other recommendations for additional research.

Subject Headings

Real estate investments, Commercial property returns, Real estate returns,
Determinants of real estate returns, Fundamental determinants of property returns,
Macro economic determinants of property returns, Model for property returns.

Acknowledgements

I wish to express my sincere appreciation to the following individuals whom contributed towards the completion of the dissertation:

My wife, Marianne, for her general support, sacrifice and patience with her husbands' MBA studies during the past three years and in particular the past year.

Prof Ines Nel, for his availability at short notice, advice and enthusiastic support with this dissertation.

Stan Gurren, Michael Levin and Johan Soghne, from the Investment Property Databank (IPD) whom sponsored the data used in the study.

My parents, Rita and Gert Kotze, Petro Botha and close members of family for their words of comfort.

Maya and Oscar for their endurance and 'suffering in silence'.

And last, but definitely not least, the Lord, for giving me the opportunity to participate in this course and dissertation as part of the His Greater Plan for me.

2 November 2005

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Glossary

Note to the reader: A few terms are provided here to avoid confusion in the text that follows.

Capitalization Rate (CAP Rate)

In real estate appraisal, capitalization is the process of converting constantly growing income, for example, rental income, to a property value (CHABOT, 2005). The capitalization rate or CAP Rate for short, is the first year's expected net operating income, assuming the whole building is let at open-market rentals, divided by the purchase price (Rode, 2004:4). The calculation ignores VAT and transfer duty. For example, if an investment property is acquired for R120,000 and can generate R1,000 per month after all operating expenses (before debt service), then the CAP Rate would be R12,000 divided by R120,000 or 10 percent. This means it will take approximately 10 years to recoup the property value in net rental income assuming the rent stays the same.

The fundamental reason why capitalising the first year's net income is often not the preferred method for assessing property value is that the method cannot discount uneven future cash flows and there is little attempt other than a subjective tweaking of the capitalization rates to quantify the expected future growth of the investment (Strickland, 1999:20). It can however, be used as a short-cut method of discounting future cash flows if there is constant escalation.

Discount rate

The discount rate is the interest rate or investor's required rate of return that is used in determining the present value of future cash flows, in a discounted cash flow analysis. (Brigham & Ehrhardt, 2002:295)

Discounted cash flow versus capitalization

Equation (1) below, also known as Gordon's (constant) Growth Model (Brigham & Ehrhardt, 2002:389), is an example of a form of discounted cash flow, a process which is based on the principle that time has a monetary value.

$$P_0 = \frac{D_0(1+g)}{(1+r)} + \frac{D_0(1+g)^2}{(1+r)^2} + \dots + \frac{D_0(1+g)^\infty}{(1+r)^\infty} \quad (1)$$

The terms have the following meaning:

P_0 := Price or value of an asset in period 0

D_0 := Net income or dividend in period 0

g := A constant growth rate in perpetuity

r := Total return (hurdle rate) required by investors, that is, income return plus capital growth rate.

As long as $r > g$, Equation (1) can be simplified as follows:

$$P_0 = \frac{D_1}{r-g} \quad (2)$$

or

$$P_0 = \frac{D_1}{k} \quad (3)$$

where

$$k = r - g \quad (\text{the capitalization rate})$$

Equation (3) is known as the capitalization formula, and it is widely used by professional valuers (Rode, 2004:2). The process described above is known as Capitalization. This process is a form of discounting that assumes, for example in the case of real estate, a constant growth rate of cash flows from rental income, in perpetuity; an assumption, which is not always correct. For instance, an existing lease could expire and the property owner might decide to adjust the rent by a percentage higher than the current rental growth or inflation rate. The assumption of constant growth rate in perpetuity would thus not hold over the period starting from the beginning of the previous lease until the end of the new lease.

Hurdle rate or required rate of return for constant growth

After rearranging Equation (2) above, the hurdle rate or required rate of return can be

enumerated, for example, for real estate (once again assuming a constant growth in net rental income):

$$r = \frac{D_1}{P_0} + g \quad (4)$$

The hurdle rate is the only rate that may be used when discounting a series of cash flows for valuation purposes, because in the long term, this is the total return that investors forgo when not invested in a specific property (Rode, 2004:18).

The hurdle rate of a specific property is of course a function of such a property's risk and other factors, which forms the topic of this dissertation.

An example of a direct capitalization (that is for constant growth, g):

$$\begin{aligned} D_1 &= \text{R}10.00 \text{ (Ten Rand)} \\ r &= 0,22 \text{ or } 22\% \\ g &= 0,10 \text{ or } 10\% \end{aligned}$$

$$\begin{aligned} \text{Which yields the Value} &= \frac{10.00}{0.22 - 0.10} \\ &= \frac{10.00}{0.12} \\ &= \text{R}83.33 \end{aligned}$$

Initial yield

The initial yield (Rode, 2004:4) is the first year's expected net operating income, based, amongst other factors, on existing leases, divided by the purchase price. This calculation excludes VAT and financial charges such as, for example, transfer duty.

The following should be noted with respect to CAP rate and Initial yield:

- The initial yield and cap rate are the same in only those rare cases where a building is let at open-market rentals.
- Where a building is let at well below today's market rentals, the initial yield on

market value will be well below the cap rate. Thus, the potential buyer of such a property will be prepared to forgo a higher initial income yield now in anticipation of the steep growth in income in the future when rental cash flow will revert to today's much higher market level.

Of the above two yields, the cap rate is the only valid and feasible yardstick to evaluate the price or market value of a property (Rode, 2004:18). This is so because it standardizes the rental assumption, viz. by assuming market rentals, which makes inter-property comparisons possible. With the exception of those few properties let at market rentals, each property has a different initial yield (because of differing lease renewal profiles), which makes inter-property comparisons impossible. For this reason one finds market evidence only on cap rates, not initial yields.

Rental value growth

The increase in the estimated rental value of properties held throughout the measurement period, expressed as a percentage of the rental value at the beginning of the period.

Total Return

Total return is defined as the sum of capital growth and income return (Rode, 2004:2).

CHAPTER ONE: INTRODUCTION

1.1. Introduction

Real estate¹ (Wikipedia.com, 2005) is a legal term that encompasses land along with permanent fixtures to the land, such as buildings. The term derives from the feudal principle that in a monarchy, all land was considered "royal estate" or in other words, 'the property of the king'. Today still, investors are attracted to real estate since it has several appealing attributes: Like a stock, it can be held for the purpose of capital appreciation (analogous to an increase of stock price) and/or revenue generation (analogous to receipt of dividends) in the form of rent collection.

Total returns - % per year				
	All property	Retail	Office	Industrial
2000	11.1	10.3	12.7	7.0
2001	10.5	13.2	7.8	7.5
2002	9.6	11.0	5.0	8.8
2003	15.3	17.3	8.9	17.7
2004	23.4	26.1	16.7	24.4
Annualised over:				
3 years	15.9	18.0	10.1	16.8
5 years	13.8	15.4	10.1	12.9
10 years	13.4	16.0	9.9	12.2

Table 1.1: Total Returns on commercial property (source: Investment Property Databank, 2005)

Currently the outlook for the returns in the commercial real estate market in South Africa is optimistic based on an average total return of 23.4% received in 2004 and 15.3% return of 2003 (see Table 1.1). Further, in 2004, commercial real estate delivered the highest average return seen over the past ten years.

¹ Note: In this dissertation the terms 'real estate' and 'property' will be used interchangeably. Commercial real estate is that class of real estate that is used to transact various forms of business that includes trading, manufacturing or storing of goods and services. For a more elaborate definition of specific types of commercial real estate, the reader should refer to section 1.4 below.

The Investment Property Databank Ltd (IPD) stated in its 2004 report (Investment Property Databank, 2005) that direct property certainly deserves a position as an attractive alternative to an investment on the securities exchange. In view of the current upswing, which is strongly driven by the growing South African economy, IPD anticipates that many more investors will start to participate in the 'frenzy'.

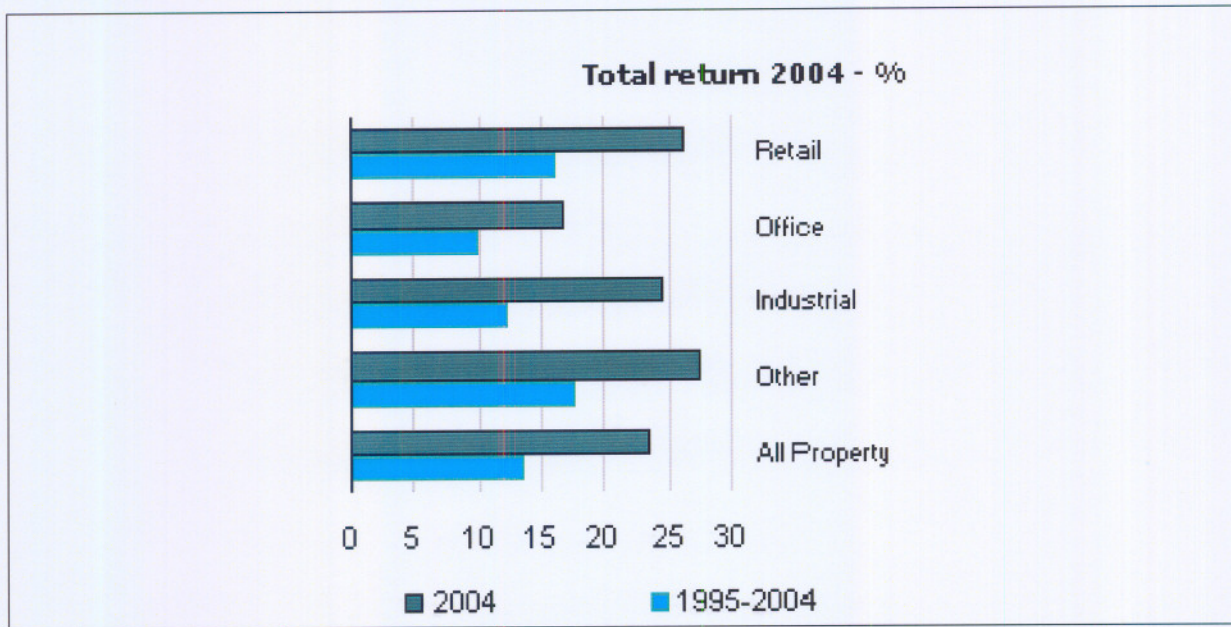


Figure 1.1: Total return for property types in South Africa, 2000 to 2004. (source: Investment Property Databank, 2005)

In the field of real estate, the majority of the research contributions in South Africa are from Rode & Associates, the South African Property Owners Association (SAPOA) and the IPD. These firms and organizations publish financial performance information that includes the observed total average returns on properties for different geographic sectors (nodes) and property types. Financial institutions and listed real estate firms also monitor average rates of return for property in the portfolios under management but do not make this information readily available to the public. These institutions prefer rather to participate in the SAPOA or IPD panel valuation initiatives.

1.2. Problem definition

1.2.1. Background

It is a well-known principle for a market dominated by risk-averse investors, that riskier securities must have higher expected returns, as estimated by the marginal investor (Brigham & Ehrhardt, 2002:210). From this paradigm and in view of the current upswing in the commercial real estate market, an investor considering an investment in the commercial property sector is likely to be confronted by several issues. These issues include amongst others (1) uncertainty about for how long the upswing or boom will last and (2) what are the determinants of the required rate of return that should be taken into account, to compensate the investor for risk. This dissertation will focus on addressing the second issue, which is: "What are the determinants of required rate of return in commercial real estate in a South African context?".

The reader should be aware of possibly at least two distinct perspectives on addressing this problem (Johnson and Vernoooy, 2004). A first perspective could be from the point of view of a business owner-occupier. Such a person could derive utility from a commercial property since it is a fixed asset held by the enterprise to transact various forms of commerce as well as manufacturing and storing of goods and services. The business owner (as opposed to the market as a whole) could, in the decision to acquire a specific property, be strongly influenced by for example, (i) sentimental factors, (ii) utility aspects such as layout as well as (iii) prestige attributes of the property. Further, for the business owner, maximizing return on the equity (and/or debt) used for acquiring a productive asset (the commercial property), would form part of a more elaborate effort to maximize return of all equity deployed in the business. The owner-occupier would seek return on investment of the same order or at least at a rate exceeding the financing costs (for example, interest on the mortgage or long term loan) charged by the bank for financing the property.

The second perspective on the problem statement could be held by parties such as institutional investors (for example, Old Mutual, Sanlam), listed funds (for example, Sycom, Grayprop and Spearhead) or valuation professionals. This segment would be

mandated by shareholders to acquire a commercial property to benefit from appreciation of the value of the asset as well as the asset's ability to generate a cash flow stream in the future². Such investors would approach the acquisition of a property from a less emotional point of view than a business owner and would seek returns that would compensate for risk and cost of capital deployed on the specific property in excess of a risk-free rate (which is typically the long-bond rate). Lastly, the operational and financial issues faced by the tenants would not be of concern (at least for as long as the tenants pay rent on time and do not damage the property!).

This dissertation will approach the problem definition (as stated below) from the second point of view on property investment.

1.2.2. Statement of problem

The required rate of return is an important input parameter in valuation of a property. According to Rode (2004:20), the value of a property should be determined using a discounted cash flow (DCF) based valuation method. Any DCF method requires an appropriate rate to discount the expected revenue stream, generated by the property in future, to present value terms. The appropriate discount rate or so-called hurdle rate will have to be sufficiently high to compensate the investor for risk as well as cost of capital (and debt) and if attainable, will induce the investor to undertake the investment.

Failure to accurately account for the underlying determinants of required rate of return (hurdle rate) could lead to biased valuations and erroneous investment decisions since the investor could for example under estimate the hurdle rate. To demonstrate this fact, one can consider the Gordon formula (Brigham & Ehrhardt, 2002:389), which gives the present value of a cash flow that grows at a constant rate in perpetuity. Now, if the required rate of return is calculated to be too low, the present value of the future cash flows from the property will be too high, that is, the property will be over-valued. For an equivalent cash flow, it follows that an over-estimated required rate of return could under-estimate the value of the same property.

² Capital appreciation could be driven by favourable economic factors (for example increase in disposable income of individuals, lower interest rates and higher consumption of goods and services) that increases demand and leads to higher prices of residential and commercial real estate. Cash flow could be derived from rental income from the property net of operational expenses such as maintenance costs. These economic factors that influence returns will be review in detail in Chapter 2.

In a literature study (please refer to chapter two) it will be shown that several factors are responsible for explaining required return on commercial property. Various researchers have derived multi-factor models that describe required rate of return within the context of the United States of America (US) or European Union (EU). These models attempt to describe variations in the required rate of return as a function of:

- time,
- property type (e.g. hotel, office, retail),
- weighted average cost of capital or band of investment parameters,
- inflation, liquidity and maturity risk determined by the spread between long and short term government bonds,
- price/earnings ratio of the security exchange (i.e. alternative investment returns); and,
- location.

However, multi-factor models for required rate of return are not available, tested or published for South African conditions. In contrast to peers from the US and EU, the South African practitioners in the field of real estate valuation and investment most often base their choice of hurdle rate on several qualitative, discretionary and experience based factors. These factors include:

- the strength of the type of tenant,
- the level of landlord involvement,
- economic conditions (e.g. expectations of inflation),
- type of industry,
- location,
- vacancy,
- price,
- size,
- utility and property type,
- market rental rates and lastly; and,
- the returns of other similarly rated properties.

In conclusion, it is thus argued by the author of dissertation, that real estate analysts and investors could benefit from an elaborate, multi-factor empirical model for required

rate of return on commercial real estate in South Africa as follows:

- It could improve quantification and strength of (or contribution by) the determinants to yields and property pricing,
- It could improve the understanding of determinants of required rate of return; and,
- It could assist with return forecasting.

1.3. Study objective

1.3.1. Main objective

The main objective of this study is to establish the theoretical, explanatory variables of property returns in the SA context. In order to fulfil the requirements of the main objective, a literature review will be conducted of the existing frameworks for US and EU based property returns as well as the simple (mostly single factor) models pertaining to the South African property market. The outcome of the main objective will be a tabulated list and description of the relevant explanatory variables for property returns in SA. The rationale for selection of the set of explanatory variables of returns in SA property will be provided and critically reviewed.

1.3.2. Sub-objectives

The study will entail the following sub-objectives that are mainly organised around an empirical study of the theory encountered during fulfilment of the main objective:

1. At the end of the study, to present an empirically established, multi-factor model of property returns based on a study of the theory of required return rate for real estate. The purpose of the model should be to assist a valuation professional or investor with investment decisions in the commercial real estate market. In practice, the model should be such, that the investor could input property market fundamental data and economic data in order to calculate the required return on the specific property type in a specific area.
2. The study will focus on four specific geographic sectors (nodes) namely Cape Town, Bloemfontein, Durban and Pretoria. The returns from three commercial

property types namely retail sites, office buildings and industrial sites will be investigated for each of these four nodes. The study will not attempt to explain a commercial real estate index comprising many properties across various segments and will focus on properties that are traded in the direct property market.

3. To identify and quantify in each geographic node the contribution by the respective premiums of non-diversifiable risk in the SA commercial property market.
4. To identify and quantify in each geographic node the contribution by the relevant property market fundamental parameters related to three property types namely retail properties, industrial properties and office buildings.
5. To empirically establish (measure) for each property type the excess premium that account for location (geographic node) relative to the returns reported for the specific property type nationally.
6. The standalone risk, as measured by the coefficient of variation, will be used to identify the commercial property type and node that will be selected by a rational investor if standalone risk was the only consideration in the investment process.

1.4. Scope and boundaries

The study will focus on the South African commercial real estate industry and in particular, the required return rate which is based on total return observed in four nodes from 1995 to 2004 for the following property types:

1. Retail properties, defined as physical establishments where goods can be transacted such as shops, banks buildings, bakeries and restaurants.
2. Office buildings, generally defined as a property not older than 10 years, unless renovated. The property is used as a place of business especially for clerical, administrative or professional work.
3. Industrial properties which include physical establishments where goods are manufactured, reworked or stored such as warehouses, bulk-storage facilities, fuel depots, sawmills, factories, power-generating plants and so forth.

1.5. Research methodology

The research will start with a literature review of Modern Portfolio Theory (MPT) based frameworks for required return rate on assets, as well as five, non-MPT single- and multi-factor models that address required return on specifically real estate. A review will also be conducted of capital market and economic determinants of return in commercial property investment. A summary of the review will be provided in tabular format and the author of this dissertation will discuss the relevance of the theory to real estate and specifically to the SA commercial property market. On completion of the literature review, a set of possible explanatory variables of return on SA commercial property will be accumulated in matrix format together with the justification for selection as well as the expected contribution by each variable in explaining returns.

The next phase of the study will entail accumulation (in a matrix format) of data related to the likely determinants of required return rate on a commercial property investment in each node and for each property type. Multiple linear regression and descriptive statistics measures such as mean, coefficient of variation, coefficient of correlation, regression coefficient, F- and t-tests will be applied to the matrix in order to develop a model that explains required rate of return as reported in the Investment Property Databank (IPD). These measures and techniques will be required to determine the significance and explanatory strength of each of the determinants of return as identified in the literature review. The software package Microsoft Excel, will be used for the statistical analysis in order to evaluate the integrity of the data and quantify significance of parameters.

1.6. Limitations of this dissertation

1. The multi-factor model for return will be devised using applied mathematics and descriptive statistics in order to explain empirical observations of rate of return over a cross section of real estate data that is reported by an authoritative database in the industry. The model will thus not be devised from an existing economic or portfolio theory.
2. Due to the strategic importance of information to corporations and clients, there is reluctance by asset managers and owners on disclosure of in-depth

information for individual properties. This phenomenon results in fewer parameters that can be empirically investigated and might in turn influence the potential number of determinants that can be tested as inputs in the model. Restrictions on input data could also result in a portion of returns remaining unexplained, which will probably manifest in large, unexplained residual or error terms and/or low correlation of explanatory variables with returns.

3. The publicly available financial performance data are in the form of aggregated data per property type and region. The data are collated from individual properties held in a selection of portfolios. The performance of individually held properties is not readily available publicly. If the information is made available, the property is often not necessarily valued in consistently the same manner that could make comparison to other properties possible.
4. The model will only be relevant to the three types of properties described above, namely office buildings, retail and industrial properties found in four nodes namely, Cape Town, Bloemfontein, Durban and Pretoria.
5. The IPD database, which will be used to perform the empirical study, comprises 2232 properties, starts in Y1995, and ends in Y2004. The time series of data as such is a relatively large sample for comparison to other economic and capital market data. However, the sub-sample of data pertaining to property nodes and property types, which will be selected from the national database (of 2232 properties), is smaller (see Chapter 3 for a statistical description of the sample). The smaller sample per node and property type would result in a smaller amount of data available to analyse and would potentially result in relative large residuals or uncertainties in the empirical model.
6. It is assumed that the economic and capital market data that is extracted from the South African Reserve Bank quarterly bulletins as well as the Statistics South Africa Web based database are consistent and have integrity beyond doubt.

1.7. Exposition of chapters

Chapter Two: Literature review

The chapter starts with a discussion of the different property types that are analysed in this dissertation. Next, the two options for real estate investment, namely, direct and indirect real estate are discussed. Then will follow an elaborate literature review focussing on the relevant theories that describe the relationship between risk and required return rate for an investment. The existing approaches to describing required rate of return in real estate investment will be included in the literature review. The available tools to measure risk of an investment are described for a standalone as well as a portfolio context. The chapter will conclude with a tabulated summary of the theory and a review of the relevance of each parameter to real estate returns and the SA property market. A set of possible explanatory variables of return will be arranged in tabular format and the rationale of selecting these variables will be given. The identification of explanatory variables and critical review thereof will be the primary outcome pertaining to the main objective of the study.

Chapter Three: Methodology and results of data capturing, data processing and model building

The chapter will empirically investigate and apply the theory described in Chapter Two in a SA context and will thereby address the secondary objectives of this study. The chapter will discuss the methodology for determining a model that attempts to explain the required rate of return reported by IPD for each property node and property type. Specific aspects of the methodology that are covered include:

1. Data acquisition and sample selection methodology;
2. Data processing as well as a statistical description of the samples pertaining to the possible individual determinants of property returns
3. Statistical and mathematical quantification of the explanatory variables of property returns.
4. Statistical methods as well as the measures that were taken to ensure that the determinants of required return are statistically significant.

The chapter culminates with a mathematical equation or model for required return rate for each region and property type.

Chapter Four: Discussion of results

This chapter presents and interprets the results of the empirical study with particular reference to the mathematical equation for the required rate of return as derived in chapter three.

Chapter Five: Conclusions and recommendations

The conclusions, recommendations and suggestions for further studies are described.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

As mentioned in chapter one, especially commercial property is presently an attractive asset class for inclusion in an investor's portfolio. However, as with any investment the investor should take cognisance of several factors prior to undertaking the investment. Firstly, there are two types of real estate assets that an investor could hold namely, direct real estate and indirect real estate. (Chapter 1 already described aspects of the three real estate types namely retail, office buildings and industrial properties that will be considered in this study. A more elaborate discussion of the different direct real estate property classes will follow below. Indirect real estate investment vehicles will also be discussed). Secondly, as with all investments the investor should consider the types of risks associated with the investment in real estate. Thirdly, when valuating the acquisition price of a real estate asset, the investor should be aware of different valuation methods³ used (however, which falls outside the scope of this study). Finally, and most relevant to this study is an investor's cognisance of the different methods or models for determining the required rate of return that is used in the valuation method.

2.2. Direct real estate investment

Direct real estate investment refers to physical properties held directly (or actively) by an investor (Geurts & Nolan, 1997:20). Most direct commercial properties are owned by institutional investors, such as banks, pension funds and life insurance companies. The options for direct investment in real estate include:

1. Residential properties; and/or,
2. Commercial real estate which includes Undeveloped land, Office buildings, Retail and Industrial properties.

³ Valuation is typically a method based on discounted cash flow analysis of a series of free cash flows from the property rental income net operating expenses.

2.2.1. Residential property

Residential property includes for example a residence or an apartment that is acquired for generating rental income to the owner in the long term. Some residential property investors prefer to hold a property in order to benefit from capital gains as the investors plan to sell the property in the future. These investors are thus not primarily interested in receiving stable rental income. In addition, the following should be observed:

1. This type of real estate is popular amongst beginner investors since these investors perceive risk to be low because of familiarity with the operation of a residential home or apartment.
2. Regardless of the reason for acquiring residential real estate, investors should be aware of the cyclic nature of the residential property market. For example, rental income can in general be increased with inflation, depending on the location of the property and availability of tenants (demand). However, during an upswing in the market, the supply of rental property could exceed demand and the rental income could decline.
3. A significant disadvantage of residential property investment in South Africa is legislation that protects tenants from eviction when the tenants default on rent.
4. Development of a particular sub-class of residential property namely golf estates have lately come under legislative pressures due to the environmental impact of such developments. It is anticipated that such developments will in future be limited by legislation, which could lead to higher prices in this real estate category. Consequently, golf estates will become out of the financial reach of more property investors.

Establishing the required rate of return for residential real estate investment falls outside the scope of this dissertation.

2.2.2. Commercial real estate

2.2.2.1. Office buildings

Office buildings are generally perceived (Geurts & Nolan, 1997:22) to be trickier as an investment relative to residential property since this type of real estate

requires a greater knowledge of property management and leasing.

In addition, the following considerations pertain to office buildings:

1. Office buildings can be sub-divided into two main types: (1) suburban low-rise buildings, which is often favoured, by first time real estate investors and (2) medium- and high-rise buildings in the city centre or on the perimeter of the city in new nodes of development such as office parks.
2. The lease period for offices is generally longer compared to residential properties and typically spans a minimum of two to five years. Longer lease periods tend to bind tenants for longer periods, which results in a more predictable (and long term) cash flow stream from rental income.
3. Rental (in terms of rate per square meter) is not regulated through legislation.
4. The property owner can furnish the property but often only provide a shell to the tenant. Unlike residential properties, the operating expenses (for example, normal maintenance and renovations) related to an office building, can thus be shifted upon the tenant.
5. A main disadvantage of an office building is that the purchase price is substantially greater compared to residential property due mainly to the higher cost of land and better quality construction as well as specialised engineering-structural requirements.

2.2.2.2. Retail property

An example of *Retail property* is a *shopping centre*, which could, if suitably located, generate an attractive, secure and stable rental income from tenants that provides goods and services to the public. As with other commercial properties, screening of tenants upfront, good property management and lease contract sophistication is essential for success with this type of investment. In addition, the following practical aspects could be considered:

1. It is becoming increasingly difficult to find a suitable location for development of new shopping centres. This is due to community resistance, which has culminated in restrictive zoning and environmental controls, which therefore limits the availability of sites for new development.

2. Like offices, newly established retail nodes often draw anchor tenants as the node become the flavour of the month (or year!), leaving existing nodes vacant. This phenomenon holds risk to a retail property investor due to the potential increase in vacancy rate of a property in an aging node (for example, CBD of Johannesburg up to five years ago). Other related exogenous factors that introduce risk to an investor are aging of infrastructure and design, new layout requirements, changes in trade area income levels, demographics (aging of a trade area or aging of the population) and geographics (depopulation of city centres).
3. Lately, the trend in especially Gauteng and the Western Cape (for example, Century City) has become to combine office, retail and residential properties in life-style developments, which has made these nodes very attractive to investors and tenants alike.

2.2.2.3. Industrial properties

Industrial properties refer to warehouses as well as factories and industrial parks, which are mainly used to manufacture goods or provide a logistical utility such as storage of final goods or raw materials. Factories or light-industries are considered a more risky investment than offices or residential property. The primary reason is that these property types are usually commissioned to fulfil a specialised production or manufacturing function and are not easily convertible to another use. The utility of such a property will thus be limited to the current usage unless a significant capital layout is undertaken to make it useful for other industries.

Warehouses (Geurts & Nolan, 1997:24) are the most popular type of industrial property amongst investors since this property type have a long economic life and require relatively little property management effort. Other practical considerations for industrial property investment include:

1. Major industrial companies or large retailers often lease warehouses for a long period of time, which can provide the investor with a predictable, long term monthly cash flow.
2. An opportunity exists to let out a warehouse on a per square meter basis

required by a tenant while letting the remaining, under-utilised space in the property to another tenant. Consequently, potentially higher returns can be generated from multiple tenants as opposed to one tenant that rents the entire warehouse.

2.2.2.4. Undeveloped land

Undeveloped land will not be included in this study but is briefly discussed for the sake of completeness. Considerations for investing in this class of commercial property are as follows:

1. Undeveloped land is seen as the most risky investment of all commercial property types. This is partly due to the fact that infrastructure such as telephone, water and electricity are absent as the undeveloped land is often located on the outskirts of town.
2. The investor could acquire undeveloped land with the expectation that the land will become desirable to industrialists in future years as the town expands. The investor thus needs to be knowledgeable of the anticipated trends for growth (for example, obtain information from town planners) and expansion of an area.
3. Undeveloped land is not an ideal investment from a budget planning and cash flow point of view. The reason is that, initially for an uncertain period of time, the monthly cash flow from the property is negative, due to the obligations of property tax and maintenance costs (for example, clearing to land to prevent fires) in the absence of revenue. An investor can buy a property like this with the expectation that negative cash flows are recovered as a result of prospective capital appreciation of the land in years to come.

In conclusion: Investing in direct commercial real estate requires property management expertise and high capital layout. Operating expenditures are sometimes required even in the absence of revenue generated by the property. In view of these considerations, it can be said that direct commercial property is only within financial reach of high net worth individuals, syndication groups or asset managers such as life insurance and listed property management firms (Geurts & Nolan, 1997:24).

2.3. Indirect real estate investment

Indirect (or passive) properties comprise securities issued (to raise capital) against a portfolio of physical properties. Through securitization, the portfolio of properties becomes a financial as opposed to a physical asset (Geurts & Nolan, 1997:22). The portfolio of physical real estate can generate income through renting, leasing and selling of property and the fund or asset manager distributes income directly to the holder of the security on a regular basis. Indirect real estate provides access to the property market for typically the less affluent or less experienced investor. Investors falling in this category are often deterred by the (i) high acquisition and operating costs as well as (ii) property management expertise required by direct real estate investment. Listed property (mutual) funds and Real Estate Investment Trusts (REIT) are examples of indirect real estate.

Indirect real estate property funds and trusts (Investopedia, 2005) can be categorised according to the type of real estate investments that the fund(s) comprise. The following three categories of indirect real estate are encountered: (1) equity trusts, (2) mortgage trusts and (3) hybrid or combination trusts. *Equity* trusts have at least 75 % of their invested assets in real estate properties and are mandated not to enter in short-term, speculative transactions but rather obtain earnings from property rentals. A trust is classified as a *mortgage* trust (Geurts & Nolan, 1997:23), if at least 75% of the invested assets are tied up in short-term or long-term mortgage loans against property. The primary source of income for a mortgage trust is from interest earned on short- and long term mortgage portfolios or from commissions and discounts on mortgages purchased. Short-term mortgage trusts typically offer mortgages (usually funded through use of commercial paper or bank loans) for six- to twenty four-month construction and development projects. Long-term mortgage trusts mostly invest in twenty- to thirty-year amortized loans which could also include equity participation loans. *Hybrid or combination* (Investopedia.com, 2005) trusts have characteristics of both equity and mortgage trusts and are mandated to develop property, own property, lease property, provide mortgage financing and land development loans.

2.4. Risk

Risk can be defined as *the probability that an investment's actual return will be different from expected* (Brigham & Ehrhardt, 2002:201). The concepts of risk and return can therefore not be separated since no investment should be undertaken unless the expected return is high enough to compensate the investor for the perceived risk of the investment.

The riskiness of an asset can be considered in two ways: (a) On a *standalone basis*, where the asset's cash flows (for example, returns by a commercial property in the form of rental income net of expenses) are analysed in isolation, or (b) in a *portfolio* context, where the cash flows from a number of assets are combined and then analysed. In case of the latter, there are two main elements associated with an asset's risk namely (1) systematic and (2) unsystematic risk:

1. Systematic or non-diversifiable risk

Systematic or non-diversifiable risk is inherent in market movements and cannot be diversified (Brigham & Ehrhardt, 2002:266). Non-diversifiable risk has an impact on all firms in an economy and cannot be eliminated by investing in multiple firms across many geographic areas and industries. Examples of non-diversifiable risk include inflation, recession and high interest rates. In the case of real estate, systematic risk can arise from changes (expansion or contraction or structural changes) in the local, regional, or national economy as well as socio-political changes. For example, cities in the USA, such as Houston and Denver suffered high commercial and residential vacancy rates when the price of oil collapsed in 1985.

2. Unsystematic or Diversifiable risk

Unsystematic or diversifiable risk is industry or company specific (Brigham & Ehrhardt, 2002:266). Examples of diversifiable risk include events such as lawsuits, labour action, and unsuccessful marketing and merger programs. Since these risks are specific to the situation of a firm, investors can reduce the risk by

investing across multiple firms, across multiple industries and geographic boundaries. In the case of real estate diversifiable risk is property- or site-specific. For example, poor management of an office building may lead to higher operating expense levels and/or decreased occupancy. In addition, the relative attractiveness of a property's location may change due to new real estate development or road construction in the immediate area or because of some evidence that the property's environment is hazardous or potentially hazardous.

2.4.1. Measurement of risk

Two perspectives on how an asset's risk can be analysed includes the (a) standalone - and (b) portfolio context (Brigham & Ehrhardt, 2002:202). This section describes the appropriate available tools to measure risk from each perspective.

2.4.1.1. Standalone risk

The *standalone* context implies that the investor only holds one asset. The risk of holding a standalone asset will be related to the probability of the asset earning a return different from what has been expected. The tools available to measure standalone risk include (a) standard deviation and (b) the coefficient of variation.

1. Standard deviation

Standard deviation (SD) is a measure of the dispersion of a set of data (for example annual rental returns of real estate) from its mean (Investopedia, 2005). The higher the volatility of an investment returns, that is, the more spread in the return data around its mean, the higher the SD. The SD is calculated by squaring the deviation from the mean for each data point in a set of historic return data. The result is multiplied by the probability of occurrence of the specific return. These products are summed to obtain the so-called variance of the probability distribution. Lastly, the square root of the variance is taken in order to obtain the SD. If the probability distribution (of return data) is normal, the actual return of the investment will be within ± 1 SD of the expected return, 68.26 % of the time.

2. Coefficient of variation

The coefficient of variation (CV) expresses the risk per unit of return (Investopedia, 2005). It is calculated as follows:

$$\text{Coefficient of Variation} = \text{Standard Deviation} / \text{Expected Return}$$

The CV is useful to evaluate the standard deviation as a fraction of an investment's expected return, as long as the expected return is greater than zero. Should the expected return be zero, the CV would be infinite. The CV allows an investor to compare returns on two alternative investments. In such a case the rational investor would select the investment with the lower CV.

2.4.1.2. Portfolio risk

In section 2.4.1.1 the risk of assets held in isolation was considered. This section discuss the risk of an asset held in a portfolio, that is, the risk of an asset held together with a number of other assets. It will be seen, that a risky asset can be combined with another risky asset in a portfolio and the combination could be less risky under certain conditions than the same asset held in isolation. Therefore, from the investor's point of view, the fact that a particular stock's returns increases or decreases is not relevant. Rather, what is relevant to an investor is the return on the portfolio and the portfolio's risk in which the particular stocks are kept. (The total risk of a portfolio will be a function of the number of securities or assets held in the portfolio as well as on the risk of each individual security and the degree to which these risks are independent (correlated) of each other.) The tools available to measure the risk of an assets held in a portfolio include (a) correlation coefficient and (b) beta.

1. Correlation coefficient

The correlation coefficient measures the degree of co-movement between returns of investments (for example, between stocks and real estate) and ranges between -1 and +1. A perfect positive correlation indicates that the assets'

returns move on average in tandem. Alternatively, perfect negative correlation means that if return on one security moves in an up (down) direction, the return of the other security will move by an equal amount down (up). Diversification will have no effect on reducing the risk of two individual stocks that are risky in isolation and which are perfectly positively correlated if the stocks are combined in a portfolio. If the correlation is 0, the movements of the securities have no correlation, that is, it is completely random. In such a case, if one security moves up or down there is as good a chance that the other will move either up or down; the way in which the securities move is totally random.

In practice it is not likely to find perfectly correlated securities. Rather one will find securities with some degree of correlation. For example, the performance of two stocks within the same industry could be strongly positively correlated although it may not be exactly +1 (Brigham & Ehrhardt, 2002:213).

2. Beta

As noted in the previous section, one rarely (if ever) encounters two perfectly negatively correlated stocks. Even in well-diversified portfolios that comprise a large number of individual stocks, some risk (the so-called market or systematic risk as previous noted) remains after diversification (Brigham & Ehrhardt, 2002:218). Investors will require compensation (a premium) for bearing this part of the stock's risk (that is, the market risk) that can not be eliminated through combination with other stocks in a portfolio: The higher the market risk, the higher the stock's expected return must be to induce investors to buy the stock. Further, the market risk can be measured by the degree to which a given stock's returns tends to move up (down) with the market. Market risk is the relevant risk, which reflects a stock's contribution to the portfolio of asset's risk.

The Capital Asset Pricing Model (CAPM) theory is a framework for analysing the relationship between risk and return rate. The CAPM is based on the premise that an individual stock's return rate is equal to the risk-free rate of return plus a risk premium, which reflects only the risk that remains after diversification. In the CAPM, the so-called beta (β) coefficient provides a measurement of market risk or the degree to which a stock's (or asset's) returns fluctuates in relation to the overall market (Brigham & Ehrhardt, 2002:221). Since the β coefficient

expresses the amount of risk that the stock contributes to the market portfolio, it is the theoretically correct measure of a stock's riskiness. In practice β is measured by the slope of the regression line fitted through a scatter plot of an asset's historic returns (dependent variable) against historic returns on the market (independent variable).

A negative beta ($\beta < 0$) would indicate an inverse relation of an asset's returns to the market returns and is possible but highly unlikely. Some investors used to believe that gold and gold stocks should have negative betas because these asset classes tended yield an increasing return when the stock market declined, but this hasn't proved to be true over the long term.

A Beta of 0 ($\beta = 0$) implies that regardless of which way the market moves, the return of the asset remains unaffected (that is, ignoring inflation).

A Beta of 1 ($\beta = 1$) represents the volatility of a given index that represent the overall market, against which other stocks and their betas are measured. The S&P 500 or FTSE/JSE is such an index. If a stock or index fund has a beta of one, it will move the same amount and in a similar direction as the index.

A Beta greater than 1 ($\beta > 1$) denotes a greater volatility in relation to the broad-based index and would imply a higher risk for the specific stock in relation to the market.

A Beta less than 1 ($\beta < 1$) denotes less volatility of an asset's returns in relation to the market portfolio returns.

It can be proved from the CAPM theory that a stock's β is inversely proportional to the SD of the market (Brigham & Ehrhardt, 2002:221). Further, it can be proved that β is proportional to the SD of the stock and correlation coefficient of the stock with the market. Thus a stock with either a high SD or a high correlation with the market will tend to have a high beta. Many technology companies on the NASDAQ have a beta higher than 1. For the most part, stocks of well-known

companies rarely have a beta higher than 4.

The following example supplements the above explanation: If company A has a beta of 2 it means it is twice as volatile as the overall market. Given a market risk premium of 10%, company A is therefore expected to return 20% (in excess of the risk-free rate). On the other hand, given a market risk premium of -6%, company A is therefore expected to return -12% (in excess of the risk-free rate). If a stock had a beta of 0.5, it would be expected to be half as volatile as the market. In other words, given a market risk premium of 10%, the company's share would gain 5% (in excess of the risk-free rate).

Figure 2.1 shows IBM's stock changes for the trading period of June 2004 to June 2005 and demonstrates IBM's tendency for higher volatility ($\beta > 1$) than the S&P500 that is a proxy for the market portfolio. On June 8, 2005 the beta for IBM was 1.636, meaning that up to that point, IBM had the tendency to be 1.636 times as volatile as the S&P 500. The red line is the percentage change in IBM stock price over the period and the green line is the percentage change of the S&P 500. During the period October to December 2004, it can be seen that when the market moved up, IBM (red line) tended to move up more. During the period January to March 2004 IBM's stock price declined more than the market when the latter declined. The large drop in IBM stock from March to April 2005, while coinciding with a smaller drop in the S&P, resulted from a firm-specific risk (diversifiable type of risk): the company missed earnings estimates. From inspection it can be seen that the behaviour (large drop) of the stock price during this period, caused the SD to increase. It therefore follows from the relation of SD and β through the CAPM theory (Brigham & Ehrhardt, 2002:221) that β was also driven higher as a result of the increasing SD. By showing IBM's behaviour over this period, this chart demonstrates both the value that comes with the use of beta and the caution that needs to be shown when using it.

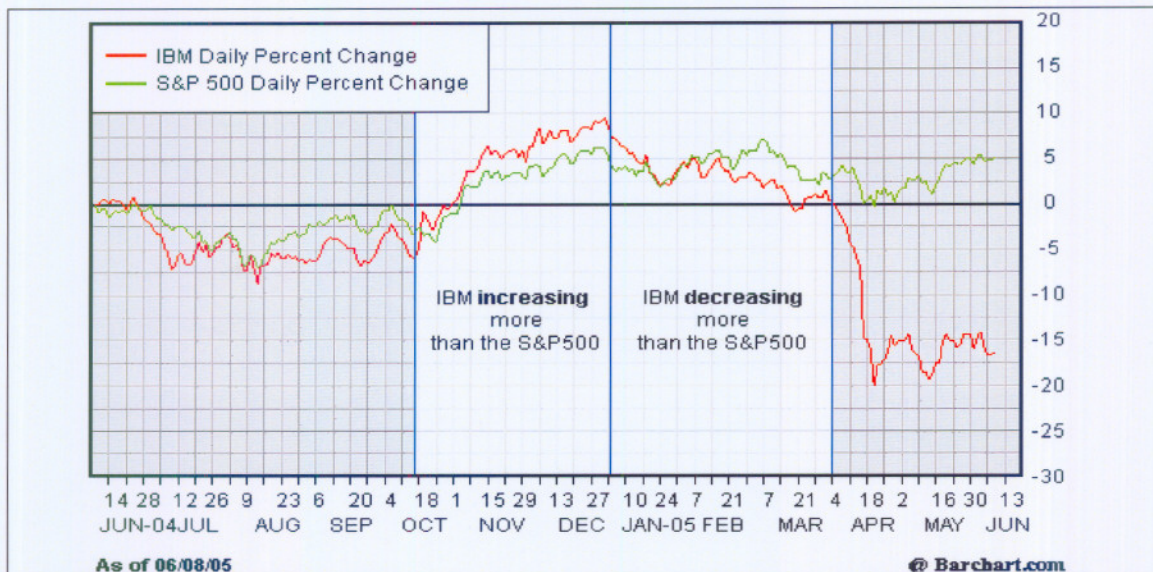


Figure 2.1: Volatility of percentage change of IBM’s stock price during the period June 2004 to June2005 (source: Investopedia.com, 2005).

2.5. Diversification benefits of real estate

To determine whether real estate should be included in a well diversified portfolio, one has to look at how it is correlated with other assets. Geurts and Nolan (1997:20) performed a literature review of research on diversification benefits of real estate. According to Geurts and Nolan (1997:22), a well diversified portfolio for long-term investors should have at least 20 percent in real estate. The reasons are as follows: for the period 1915 to 1978 there was a low correlation between the respective returns on (i) real estate and stocks, (ii) real estate and bonds and (iii) real estate and T-bills, respectively in the US markets. Further, for the shorter period of 1972 to 1983, a negative correlation between real estate and stock and bond yields, respectively was found. During this period it would thus have made sense to include real estate in a portfolio since (for example) on average when returns on real estate increased (decreased) returns on bonds and stocks decreased (increased).

In addition to the low or negative correlation between real estate and other assets, investors should be aware of the correlation *within* the asset class of real estate such as (i) the correlation between geographical regions and (ii) correlation between real estate types. Geurts and Nolan (1997:22) found in a review of past research, a high positive

correlation among six main geographic centra in the US. The latter implies for the time period under consideration, that geographic diversification in property was not adding to the degree of diversification in a portfolio of property assets. Further, these researchers found for residential real estate a negative correlation with office buildings and low correlation with retail properties. Therefore, residential real estate is potentially a good diversification tool within a real estate portfolio. Finally, a high correlation was found between office buildings and retail properties. Ziobrowski and Curcio (1991:141) reported similar results in all of the above cases.

From the review by Geurts and Nolan (1997:24) and results obtained by Ziobrowski and Curcio (1991:141), it can be concluded that real estate could potentially improve diversification due to the low or negative correlation that exists in the following contexts:

1. between real estate and other assets such as stocks, bonds and Treasury Bills,
2. between the different types of real estate,
3. across different main geographical centra within countries such as the US and EU; and,
4. between different countries and/or continents.

Finally, a specific relevance of the review by Geurts and Nolan (1997:24) to this dissertation is that correlation differences exist between returns of the respective property types and across geographical areas. This emphasises that required return rate is described by a different set of explanatory variables from one node and/or property type to another.

2.6. Relevant theories for describing required rate of return on an asset

This section reviews theories of the relation between risk and return for assets in general as well as for real estate, specifically.

2.6.1. The general determinants of required rate of return on an investment

Capital in a free economy is allocated through the price system, that is, a system whereby investors require a rate of return that is related to the risk borne by the investor

(Brigham & Ehrhardt, 2002:167). The required rate of return for an investor is expressed as the accounting ratio of the required income from an investment to the amount of the investment. Examples of returns on an asset or investment include the following: In the case of stocks, the investor anticipates to derive returns from dividends and capital gains in the future. The sum of the percentage dividends and percentage capital gains is the return on the stock. In the case of property investment, the rental income from a lease and the capital appreciation of the property form the basis for the return on the investment in the specific property.

The discussion below pertains to a framework that describe the determinants of return on, for example, an investment or debt security (such as a bond), in a general format.

The quoted (or nominal) rate of return on an investment, k , comprise a real risk-free rate of return, k^* , plus several premiums that reflect inflation, the risk associated with the investment opportunity and the marketability or liquidity of the investment (Brigham & Ehrhardt, 2002:173):

$$\begin{aligned} k &= k^* + IP + DRP + LP + MRP \\ &= k_{RF} + DRP + LP + MRP \end{aligned}$$

The terms have the following meanings:

k^* : = This term represents the risk-free interest rate (excluding inflation), that is, the interest rate that is assumed can be obtained by investing in financial instruments with no risk. A truly "risk-free" asset exists only in theory but in practice, investors use as a proxy for the risk-free rate, the yield on a number of different types of government bonds, each with its own strengths and weaknesses. (For US dollar investments or valuations, usually U.S. government treasury bills are used, whilst a common choice for EU investments are German government treasury bonds. In South Africa, 91-day treasury bills could be used for short term valuations or short term capital budgeting. These securities are considered to be almost risk-free because the likelihood of the government defaulting is extremely low.) Those who use (shorter-term) Treasury (T) bill rates (for example, 91-day T-bills in SA) argue that the shorter maturity protects the investor from interest-rate risk (that is, increase in interest rate). In addition, there

exists a low correlation of the T-bill with the stock market which make T-bills truly riskless. However, because T-bill rates are more susceptible to supply/demand swings, central bank intervention, and yield curve inversions, T-bills provide a less reliable estimate of long-term inflation expectations and do not reflect the return required for holding a long-term asset such as real estate. For valuation, long-term forecasts, and capital budgeting decisions, the most appropriate risk-free rate is thus derived from long-term government bonds. Long term bonds capture long-term inflation expectations, are less volatile and are less subject to market movements.

$k_{RF} :=$ The nominal or quoted risk-free rate of return, k_{RF} on an investment is the real risk-free rate plus a premium for expected inflation, IP :

$$k_{RF} = k^* + IP$$

The term IP represents the average inflation rate expected over the lifetime of the investment and compensates the investor for an anticipated loss of buying power. The Consumer Price Index or CPI reflects by how much the price of a representative basket of consumer goods and services have changed between two periods in time and this index therefore measures the impact of the headline or official rate of inflation on the average consumer in the main metropolitan areas of the country. (The CPIX exclude interest rates on mortgage bonds and is a measure used by the SA Reserve Bank to assist with inflation targeting.) South African CPI data could thus be used to account for an inflation premium in the process of deriving a model for real estate returns in this dissertation.

$DRP :=$ The term DRP , compensates the investor for the risk that a borrower will default on lease payments. The DRP is almost zero for Treasury Bills issued by governments of economic powers such as the US but the DRP increases as the risk level of the issuers of these instruments increases.

$LP :=$ An investment is said to be of a liquid nature if it can be converted to cash quickly at a fair, market determined value. In the case of direct real estate, the asset(s) is sold less frequently than other investments such as indirect

real estate and the investor should be compensated for the risk of illiquidity. That is, the investor will require a so-called liquidity premium, LP over and above k_{RF} . Some of the reasons for the illiquid nature of direct real estate includes the following:

1. Selling a direct property is a costly and time-consuming process;
2. Unlike units acquired in an indirect property, each property is unique.
3. Legal aspects around a property transaction is complex;
4. A market to match buyers and sellers could be absent or not well-developed.

It should be noted that in practice this type of information is not readily available or recorded in the property industry and the effect of liquidity will not be explicitly taken into account in this study.

MRP:=

Long-term investments are more exposed to interest rate changes than are short-term investments. To compensate investors for interest rate risk, a maturity risk premium (MRP) is added to the required return on long-term investments. The longer the years of investment up to maturity, the higher the *MRP* premium. The MRP 'protects' the investment so that if interest rates go up soon after an interest bearing instrument is purchased, the investor will miss out on only a relatively small amount of interest before the bill matures and can be reinvested at the new interest rate.

2.6.2. Capital asset pricing model (CAPM)

As discussed in section 2.4.1.2, the Capital Asset Pricing Model (CAPM) is a framework to analyse the relationship between risk and the return of an investment (Brigham & Ehrhardt, 2002:257). The CAPM theory states that investors are rewarded only for assuming market or systematic risk, because the investor can mitigate the diversifiable portion of risk by constructing a portfolio of investments over a range of geographic areas, industries and firms. The CAPM provides the appropriate required return or discount rate, for the asset, which is the rate at which future cash flows produced by the asset, should be discounted given that asset's relative riskiness (to the market portfolio). This section expands the discussion on the CAPM that was started in section 2.4.1.2.

The basic assumptions of the CAPM are:

1. All investors focus on a single holding period and seek to maximise the expected utility of the investor's terminal wealth by choosing among alternative portfolios on the basis of the expected return and standard deviation.
2. All investors can borrow or lend an unlimited amount at a given risk-free rate of interest, k_{RF} , and there are no restrictions on short sales of any asset.
3. All investors have homogenous estimates or expectations of the expected returns, variances, and covariance's among all assets.
4. All assets are perfectly divisible and liquid (that is, marketable at the going price).
5. Transactions costs and taxes are zero.
6. All investors are price takers, that is, investors assume that the action of buying and selling will not affect stock prices.
7. The quantities of all assets are given and fixed.

The Security Market Line (SML) is an integral part of the CAPM and express the basic proposition of CAPM, namely that additional risk requires a higher (additional) return (see Figure 2.2 which shows the SML graphically).

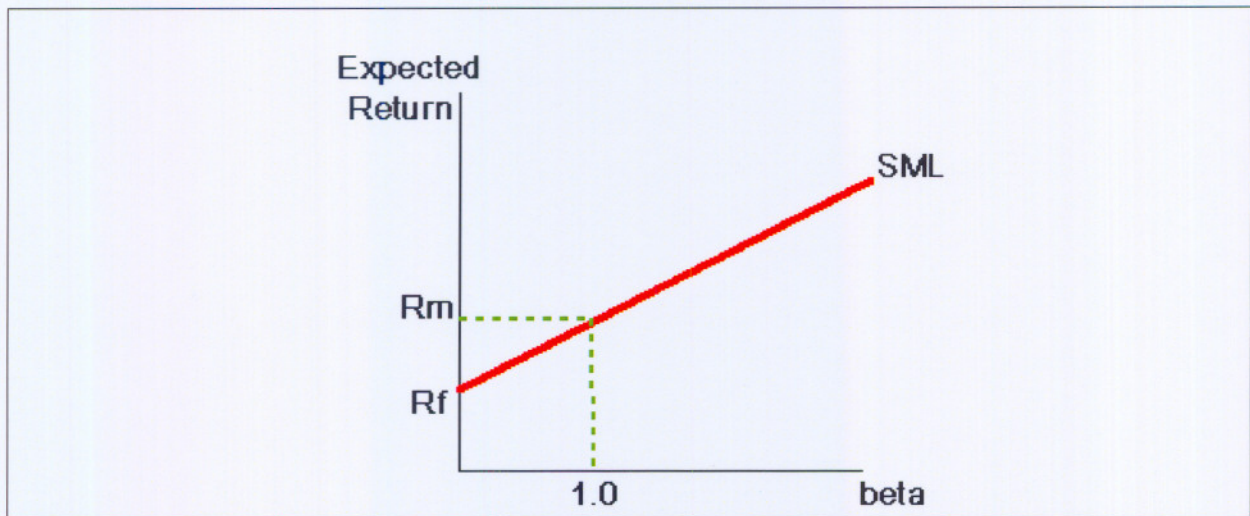


Figure 2.2: The SML line (source:own)

The SML (Brigham & Ehrhardt, 2002:231) describes the risk-return relationship for individual assets in terms of the return rate on a risk-free security and a risk premium:

$$SML: k_j = k_{RF} + (k_m - k_{RF})b_j$$

The declaration of the two terms on the right hand side of the equality is as follows:

$k_{RF} :=$ The real risk-free rate of return k^* is the return that would exist on a riskless investment if no inflation were expected. The symbol, k_{RF} denotes the sum of k^* and inflation. In a South African context, the risk-free, nearly inflation-free rate of return would exist on South African government short-term bonds (that is, the 91 and 182 day Treasury Bills). Please refer to section 2.6.1 for a more complete discussion.

$(k_m - k_{RF})b_j :=$ This term represents the risk premium, RP_j on the j^{th} stock. The factor, $k_m - k_{RF}$ (sometimes expressed as RP_M) indicates the additional return above the risk-free rate to compensate an investor for assuming an average⁴ amount of risk. The multiplication of RP_M with the beta coefficient of the j^{th} stock or asset adjusts the term, $k_m - k_{RF}$, for the volatility of the particular security relative to the market.

⁴ Average risk means a stock which moves in (exact) tandem with the general market and has by definition a beta = 1.

Investors can use the CAPM theory to determine the theoretically required return of an investment at a specific level of risk and also potentially exploit opportunities in so-called undervalued shares (in terms of the CAPM and graphically depicted by the SML equation). As an application of CAPM consider Figure 2.3 below. In the freely competitive markets described by CAPM, a security such as *Security T*, would not be priced too low for so long, that it yields more than its return predicted by the SML. Investors will find such a lowly priced security (at the specific beta value for the stock), very attractive. Consequently, investors will bid its price up until its expected return fall back to the appropriate position on the SML at the specific level of risk (beta). On the contrary, investors would sell off any security such as *Security S* that is selling at a price high enough to put its expected return below its appropriate position for the security's beta. This reduction in price would continue until the security's expected return rose to the level justified by its beta value according to the SML.

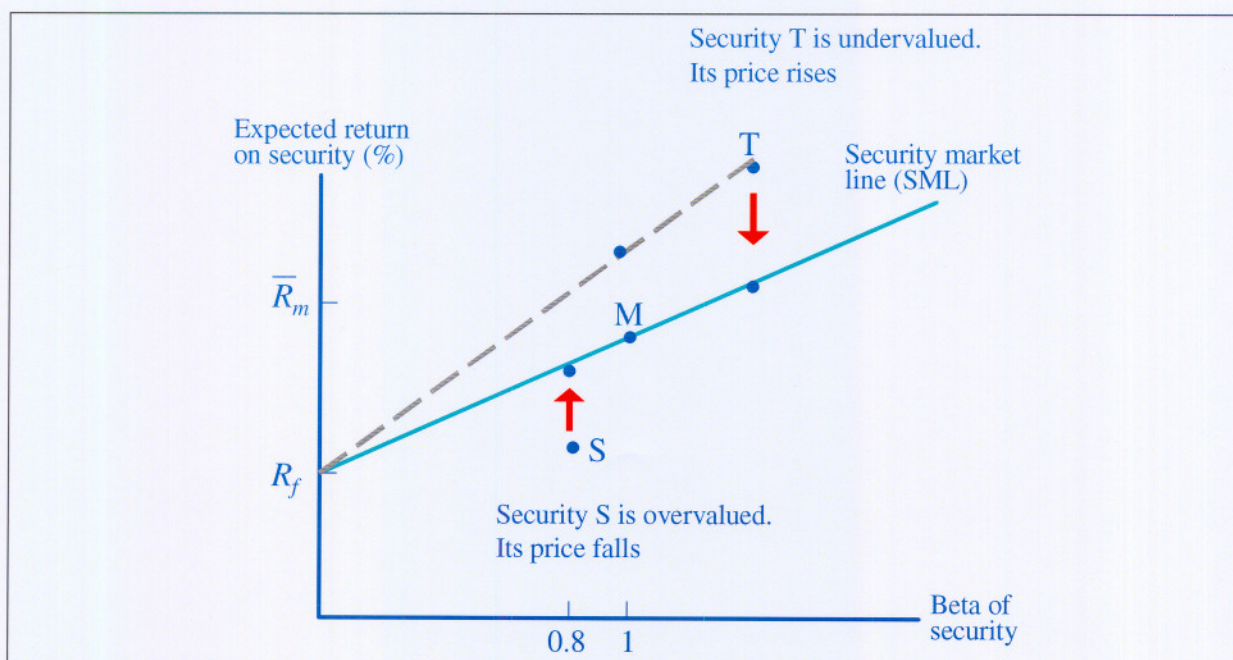


Figure 2.3: Over- and undervalued securities in the markets described by the CAPM (source:own).

Conclusion of the CAPM: The major conclusion of CAPM theory is that the relevant risk of an individually held asset or stock is its contribution to the risk of a well-diversified portfolio of assets. If held by itself, an asset can be potentially risky but its risk can be partially countered by diversification in a portfolio context. The so-called market risk is the relevant risk of an asset's contribution to the risk of a portfolio.

2.6.3. Arbitrage Pricing Theory

Arbitrage pricing theory (APT) builds (Brigham & Ehrhardt, 2002:273) on the premise that the expected return of a financial asset can be modelled as a linear function of various macro-economic factors, where sensitivity to changes in each factor is represented by a factor specific beta coefficient. The APT was initiated by the economist Stephen Ross in 1976.

If APT holds, then the following characteristic equation enumerates the expected return of a risky asset j , as a linear relationship among n factors:

$$E(r_j) = r_f + b_{j1} RP_1 + b_{j2} RP_2 + \dots + b_{jn} RP_n$$

$$r_j := E(r_j) + b_{j1} F_1 + b_{j2} F_2 + \dots + b_{jn} F_n + \varepsilon_j$$

The symbols have the following meaning:

$E(r_j) :=$	Represents the expected return of risky asset, j .
$RP_n :=$	This symbol is the risk premium of the n^{th} factor.
$r_f :=$	This symbol is the risk free rate.
$F_n :=$	This represents the macroeconomic factor(s) value.
$b_{jn} :=$	This symbol is the sensitivity of the asset to F_n .
$\varepsilon_j :=$	This symbol represents the risky asset's idiosyncratic random shock with mean zero.
$r_j :=$	This symbol expresses the realized return on the risky asset j .

The equation above shows that the realized return on any asset, j , is a *sum* of the following:

1. The j^{th} asset's expected return,
2. Increases or decreases that depend on unexpected changes in fundamental economic factors multiplied by the sensitivity of the j^{th} asset to these changes; and,
3. A random term that reflects changes unique to the asset or industry.

In the above equation, every factor is considered to be a random variable with mean zero. However, there are some assumptions and requirements that have to be fulfilled for the latter to be correct: There must be perfect competition in the market, and the

total number of assets may never surpass the total number of factors (in order to avoid the problem of singularity), respectively.

According to Brigham and Ehrhardt (2002:275), the following can be concluded from APT:

1. CAPM is a *single* factor model while APT can include any number of non-diversifiable risk factors. It is likely that the required return on a security is rather dependent on *several* fundamental economic factors such as Gross National Product (GNP), expected inflation, changes in industrial production, the spread between low- and high-grade bonds, the spread between long and short-term bonds and change in tax laws.
2. Further, it's likely that different securities are affected differently by these factors, hence the APT appears to have a sounder theoretical basis than the CAPM.
3. The APT requires fewer assumptions than CAPM and is thus more general. For example, the APT does not assume that all investors hold the market portfolio, which is an impractical requirement of CAPM that is not easily met.
4. APT could be relatively complicated to implement since APT does not identify the relevant economic factors that will have an influence on required return. In addition to APT, a factor analysis needs to be performed to determine the strength of the relevant explanatory factors.
5. Research in the field of APT is still in progress to investigate the propositions of APT further.

2.7. Other real estate specific models for required rate of return

Both the MPT theories of CAPM and APT frameworks assume that near perfect capital market conditions prevail or at least perfect arbitrage conditions exist (that is, cash constraints are absent and mispricing of assets will be almost instantly arbitrated away). However, according to Ibbotson and Siegel (1984:222), for many asset classes such as real estate and small-company securities, these conditions are often not met and the premise that only systematic factors determine returns, do not hold. These authors argue, that for these markets, other non-risk related factors play a more significant role in returns than the systematic risk factors described by the CAPM and

APT. The factors, according to Ibbotson and Siegel (1984:222), which the investors use in calculating the required rate of return include:

1. Tax deductibility of the cost of debt,
2. Liquidity (or lack thereof, in real estate),
3. Information costs (for example, the costs of marketing the property or the costs of finding a buyer); and,
4. Long-term capital appreciation that investor consider as 'compensation' for operational expenses.

In addition to these factors, real estate investors also expect to be compensated for factors such as property type, location of the property and tenancy (vacancy) rate.

This section of the literature review models for required return rate on real estate that are based on the above mentioned non-risk related factors that Ibbotson and Siegel (1984:220) and other authors have identified.

2.7.1. Ibbotson, Diermeier and Siegel's New Equilibrium Theory (NET)

As mentioned above, Ibbotson et. al. (1984:22) argue that the CAPM and APT, which build on the premise that investors be compensated for taking on only systematic risk, are not reasonably valid for real estate and small company stocks. A conceptual model, referred to as the *New Equilibrium Theory (NET)*, was proposed by the authors for required return on assets such as real estate and accounts for risk as well as non-risk determinants of required return.

The premise of the NET is as follows: The NET breaks down risk into three systematic risk components, which is, market beta, inflation and real interest rate risk. To these three components, the authors add a residual risk (or error term) which can be justified specifically for real estate as follows: In the context of the NET theory, the authors take into account that a real estate investor do not necessarily have unlimited cash in order to afford a large, diversified portfolio, which can mitigate all diversifiable risk. Further, real estate investments are typically large in value relative to the investor's portfolio and wealth and indivisibility thereof causes investors to hold highly undiversified portfolios of real estate, burdening the real estate investor with residual risk. In the NET, the residual risk can be translated into a cost, for which investors demand compensation, that is, it is

costly for an investor to diversify. The residual term is similar to the random error term in the CAPM, reflecting the difference between the actual return on a stock in a given period and the return as predicted by the SML line.

The authors applied the NET to a hypothetical parcel of real estate and the assumptions were as follows:

1. A Treasury Bill (riskless), real rate of 10%.
2. An inflation risk premium at the time of the publication equal to 0.5%.
3. A stock beta of real estate of 0.5.
4. A market risk premium of 8.3%.
5. Compensation for residual risk, tax attributes and cost of marketing which may be estimated at 1%.

The calculation of return rate is as follows:

$$\begin{aligned} \text{Required return for the parcel of real estate} &= 10 \% + 0.5 \% + 0.5 \times 8.3 \% + 1 \% = \\ &15.7\%. \end{aligned}$$

Table 2.1 below shows a categorisation by Ibbotson et. al. (1984:31) which is an extension of the NET theory and which shows the relative contribution by risk and non-risk factors to required return for various asset classes. The table refers to residential real estate (that is, condominiums and houses) but it is the opinion of the author of this dissertation that similar factors could be anticipated for commercial real estate. In particular, the following are to be considered relevant determinants of return:

1. Residential real estate exhibits a low stock market beta, that is, a low volatility of returns relative to the market comprising many diversified assets.
2. Costs related to marketability or liquidity of real estate is high for reasons mentioned in the second paragraph of section 2.7.1.
3. The strength of factors such as residual risk costs, taxability and information costs could potentially be reduced by the appointment of competent financial intermediaries.
4. Ibbotson and Siegel (1984:222) concluded that empirical information on especially non-risk factors often is not readily available. The lack of

empirical information complicates practical implementation of the NET in case of an asset class such as real estate.

Asset	Risk factors: Expected contribution*				Non-risk factors mainly related to Marketability: Expected contribution		
	Beta	Inflation	Residual risk costs	Real interest rate	Information costs	Search and transaction costs	Divisibility costs
Large company stocks	~1	L +	-0	+	L	L	VL
Small company stocks	Var	L +	L	+	H	M	VL
Treasury bills	0	0	H	>>>1	L	L	H
Residential property	L	U	H	U	H	H	VH
Gold	<=0	< 0	L	U	L	L	VL
*KEY: L=Low, VL=Very Low, M=Medium, H=High, VH=Very High, U=Unkown, VAR=Varies							

Table 2.1 : Risk and non-risk determinants of required rate of return for various asset classes. (source: adopted from Ibbotson et. al. (1984:31))

The author of this dissertation holds the opinion that the NET is described in a very heuristic manner by Ibbotson et. al. (1984:31). Further, given that information pertaining to the types of non-risk factors described in the NET, are not readily reported publicly, the application of the NET in practice is limited. However, if such information would be available, it could be worthwhile to quantify the contribution of non-risk factors to required return rate in property investment.

2.7.2. Investment Property Data Bank Ltd (IPD) approach

IPD (SAPIX/ IPD South Africa, 2004) follows two approaches to quantifying the required return rate that is used as the discount rate in valuations.

Approach 1: The rate of return should include a base rate or risk-free rate that reflects the minimum compensation that an investor require for undertaking an investment in property. The risk-free rate could for example, be the yield on long-term SA government bonds.

In addition, a *property specific* risk premium is added to the risk-free rate. The property specific risk premium is experienced based (in other words it is based on a qualitative assessment by the valuator) and considers a number of factors including:

1. The risk of property type,
2. The property's location,
3. Tenant mix,
4. Lease period; and,
5. Stable income flow from the property over the duration of the lease (that is, rent from a single blue-chip tenant over a long lease period is more desirable than that of a multi-tenanted building with shorter lease periods).

The IPD equation for the required rate of return (***to be used as the discount rate in the property valuation***) is,

$$\text{Required rate of return} = \text{long bond rate} + \text{risk premium for property}$$

For example, based on a long bond rate of 12%, and an estimated risk premium for a specific property of between 6% and 8%, the required rate of return is between 18% and 20%.

Approach 2: In the second approach by IPD, the discount rate is regarded as a function of the cap rate and the market rental growth rate. (As market rentals are quoted in gross terms, it is generally accepted that market rental growth are also reported as gross.) The equation for required rate of return in terms of market rental growth rate is as follows:

$$\text{Required rate of return} = \text{capitalisation rate} + \text{market rental growth rate (gross)}$$

For example, in the case of a capitalisation rate of 11.5% for prime decentralised offices and a market rental growth rate of 8.5%, this equates to a discount rate of 20%.

According to the view of IPD, the cap rate is determined by the rate at which similar assets have traded recently and is influenced by the following factors:

- Rates of return on comparable properties,
- Risk,
- Obsolescence,
- Inflation (perceptions),
- Gross open market rental growth rates,
- Rates of return on alternative investments,
- Mortgage rates,
- Expenditure,
- Lease covenant; and,
- Vacancies.

The major shortcoming of this theory is that it is not statistically described or quantified. However, the premise of combining the risk-free rate (long bond rate), cap rate and market rental growth rate in a multi-factor model of returns, will be investigated further in this study.

2.7.3. Ambrose and Nourse's model

Ambrose and Nourse (1993:222) presented and tested an analytical model that describes cap rate (please refer to the *Glossary* for a description of cap rate) and postulated that the cap rate should be a function of property characteristics, cost of capital and alternative investment returns. *Property characteristics*, in the context of this model refer to both property type and property location while alternative investment returns refer to the average price/earnings ratio of the NASDAQ. Ambrose and Nourse (1993:221) proposed that since cap rate is a significant component of required rate of return, the model that these authors devised, should closely approximate the required rate of return. The Ambrose and Nourse model are described by equation 1 which describes cap rate as a linear combination of several premiums or factors that determine the investor's required rate of return, that is $\tilde{R}_{i,t}$ = the observed cap rate for property type i at period t, or

$$\tilde{R}_{i,t} = \beta_0 + \beta_1 [LTV_{i,t} * MC_{i,t}] + \beta_2 [(1 - LTV_{i,t})] + \beta_3 IP_{i,t} + \beta_4 (p/e) + \beta_5 (location) + error_{i,t} \quad (1)$$

The symbols have the following meaning:

$LTV_{i,t}$ =: The Loan-to-Value ratio, or the % of the purchase price of the property that is financed by debt.

$MC_{i,t}$ =: The interest rate at which the debt is acquired.

$IP_{i,t}$ =: The inflation premium, which compensates the investor for loss of purchasing power.

P/E =: The price earnings ratio of the stock exchange.

$location$ =: The compensation for the investor for the benefits (disadvantages) of the owning a property in a specific location.

More specifically, the respective terms in equation 1, are as follows:

$\beta_0(t,i)$ represents an intercept term for property type I at time, t.

$\beta_1 [LTV_{i,t} * MC_{i,t}]$ reflects the explanatory power (strength) of *the cost of debt capital*. The term, $\beta_2 [(1 - LTV_{i,t})]$, reflects the cost of using own (equity) capital to finance the property. The inclusion of the first two terms originates from the *band of investment approach* for determination of the cost of capital in real estate investment which in turn is based on the concept of 'Weighted average cost of capital" or WACC. The WACC is the cost of a firm's capital, which is composed of return on equity, and cost of debt capital where each term is weighted according to its percentage contribution to total capital. The WACC rate can be used as the discount rate for a series of free cash flows from a project or asset in the field of financial or project management.

β_3 reflects the relative importance of the spread or difference in yield between long term and short-term government bonds, which acts as a proxy for the longer-term inflation risk, maturity and liquidity risk premiums respectively. β_4 reflects the explanatory power of the average price/earnings (p/e) ratio of the security exchange and is a proxy for the opportunity cost of forgoing alternative investment returns in the stock exchange. β_5 represents the strength of the effect of location factors on required rate of return for property type I. Ambrose and Nourse used the percentages of asset manager funds committed to a specific region during a period of time (usually a quarter)

to capture location effects. Finally, $error_{i,t}$ is a residual term that reflects error or uncertainty in the model.

The Ambrose and Nourse model was applied to a database administrated by the American Council of Life Insurance (ACLI), which tracks mortgage data for approximately 66% of commercial mortgages held by US life insurance firms. Ambrose and Nourse incorporated a regionally aggregated location factor in the model for each of five distinct regions in the USA, which were referred to as the north, south, east, west and 'other'. ('Other' was referring to foreign investment that is outside the USA). For each region, the percentage of funds invested in real estate by life insurance firms was calculated for each property type (that is, apartments, commercial retail, office buildings, commercial services, industrial and hotels). Ambrose and Nourse concluded that the model explained 85% of the variation in cap rate. Further, at the 5% significance level, all property types other than commercial and industrial property have an intercept significantly different from zero.

Ambrose and Nourse indicated by means of statistical significance tests that β_1 should be close to 1 and that β_2 was significantly positive. It was also found that cap rates are in a statistical sense, significant negatively related to the aggregate price/earnings (P/E) ratio of the stock exchange and statistically significantly positively related to expected inflation. Ambrose and Nourse found an insignificant contribution by location factors to cap rate but argued that this result might have been the consequence of using a crude (regional) measure of location in the study.

2.7.4. Lee's model

Lee's model (2001:167) provides a quantitative framework for analysing the relative impact of property type and regional differences on the property return. Lee used data from the United Kingdom real estate industry compiled by the IPD group.

The Lee-model uses *cluster analytical techniques*⁵ as an alternative to Modern Portfolio

⁵ A general question facing researchers in many areas of inquiry is how to *organize* observed data into meaningful structures, that is, to develop taxonomies. The *cluster analysis* approach to this problem encompasses a number of different algorithms and

Theory (for example, CAPM and APT) to identify the extent to which urban areas cluster by property type or region. When these techniques are applied to property market return data, the market appears to cluster by property type rather than region. However, cluster techniques are only descriptive and exploratory and thus not adequate to explicitly separate the effects of property and regional factors and quantify the relative contribution to property returns.

Lee decomposed property returns into the sum of a market return and property type and regional type factors. Lee found from a regression analysis amongst 326 properties (retail, office and industrial) that returns are mainly driven by property type factors, which accounts for 22% (average adjusted R^2) of the variability in real estate returns. This is three times the mere 8% variability in real estate returns attributed to regional factors as per Lee's analysis. These results were consistent with the work of other authors and imply that asset managers or individual investors should pay special attention to the property type composition of the portfolio in hand, before considering regional differences. The implication for this dissertation is that property type is a relative more important determinant of required return compared to location or regional factors.

2.7.5. Erwin Rode and Associates' (R & A's) model for the South African context

Johnson & Vernooy (2004) (or R & A for short) from Erwin Rode and Associates propose that the statistical technique of simple linear regression can be applied to produce equations that estimate capitalization rates (an important component of required rate of return) based on a property's gross market rental rate. As defined in the *Glossary*, the **capitalization rate** or cap rate is the expected net operating income for Year 1, assuming the entire property is let at open-market rentals, divided by the purchase price. This calculation ignores value added tax (VAT), transfer duty or income tax.

The regression equations of Johnson & Vernooy (2004) from R & A are based on the

methods for grouping objects of similar kind into respective categories in a way that the degree of association between two objects is maximal if the objects belong to the same group and minimal otherwise. Cluster analysis can be used to discover structures in property return data without providing an explanation or interpretation of the reasons why the structures exist.

premise that the gross market rental of a property is a crucial determinant of net income which in turn is proportional to capitalization rate. R & A reports a negative correlation between market-rental rate and capitalization rate, considering that the market rental of a property reflects important value-determinants such as location, grade (quality of finishes and quality of facilities), tenant mix and vacancy. An explanation for this result could be that investors are paying high prices (which is implying a low cap rate used in the valuation or DCF analysis of the purchase price of the property) for properties that currently yield a high rent per square meter income. (see Figures 2.4 to 2.7 on the following pages.) Therefore, the negative relation between cap rate and market rental rate per square meter is expected.

2.7.5.1. R & A's Office building equation

In the regression analysis of office buildings, the market capitalization rate is the dependent variable and market gross rental rates (predictors) of grades A, B and C buildings in the major surveyed areas, are the independent variables respectively. The regression was based on 25 observations in mainly decentralized nodes. With the decaying of some CBDs, Johnson & Vernooy (2004) argue that it has become necessary to exclude the following outlier nodes in the construction of his model:

- Johannesburg CBD,
- Braamfontein,
- Pretoria CBD and,
- Durban CBD.

Johnson & Vernooy's (2004) equation for Offices is (descriptive statistics for n=25 observations are: correlation coefficient $r = -0.85$, standard error (SE) = 0.73):

$$\text{office capitalization rate \%} = 19.554 - (0.1016 * \text{gross rental})$$

where gross rental = the gross market rental rate per rentable m² per month for grades A, B or C office buildings recorded for the third quarter in 2003.

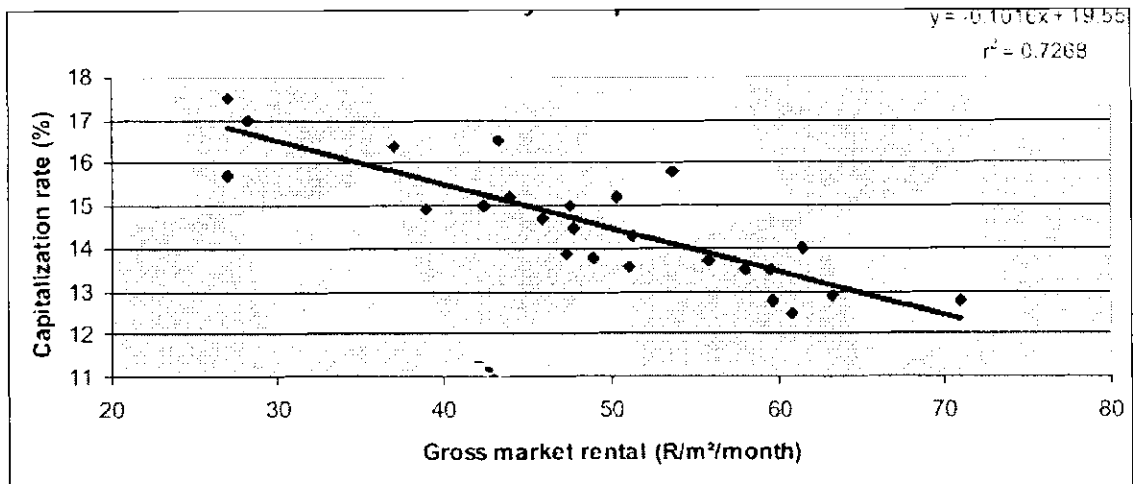


Figure 2.4 : Office cap rate vs gross market rental rate (source: Johnson & Vernooy, 2004).

Johnson & Vernooy (2004) points out that it is not advisable to use this equation for gross market rental rates that fall significantly outside the range R27/m²/month to R71/m²/month. The 25 observations used to derive the office cap rate equation also include little grade-C information. Therefore, this equation must be used with reservations when used to estimate the cap rate of grade-C office buildings (for which the regression equation will probably underestimate the capitalization rate).

2.7.5.2. R & A's Industrial property equation

The equation expresses the relationship between the capitalization rates and gross market rental rates (of size 1000 m²) of prime stand-alone non-leasebacks, secondary stand-alone industrial buildings, as well as industrial parks. For industrial property R & A presents two regression equations. The first is suitable for properties in primary industrial cities, such as the Witwatersrand, Durban and Cape Town and the second is suitable for properties in secondary industrial cities. According to Johnson & Vernooy (2004), the market is less efficient in secondary industrial cities since fewer leases are signed and few sales take place. Consequently the variance between the variables is greater. The primary city industrial regression equation is based on 18 observations, excluding Bloemfontein.

The equation is (descriptive statistics for n=18 observations are: correlation

coefficient $r = -0.91$, standard error (SE) = 0.46):

$$\text{industrial capitalization rate \%} = 19.881 - (0.4089 * \text{gross rental}),$$

The gross rental represents the gross market rental per rentable m^2 per month as recorded in the fourth quarter of 2003 for (i) stand-alone prime non-leaseback, (ii) prime industrial parks and (iii) stand-alone secondary industrial space of 1000 m^2 , located in primary industrial cities.

Johnson & Vernooy (2004) state that it is not advisable to use the equation for gross market rental rates that fall significantly outside the range R9/ m^2 /month to R17/ m^2 /month. An example to demonstrate the application of the equation: If the gross industrial rental for a 1000 m^2 building, located in a primary industrial city, is R10 per rentable m^2 per month, then the capitalization rate is: industrial capitalization rate % = $19.881 - (0.4089 * 10) = 15.8\%$.

The secondary-city industrial regression equation is based on 27 observations the sample included all primary and secondary industrial cities, except Bloemfontein.

The equation is (descriptive statistics for $n=29$ observations are: correlation coefficient $r = -0.83$, standard error (SE) = 0.59)

$$\text{industrial capitalization rate \%} = 18.732 - (0.3315 * \text{gross rental}),$$

where gross rental represents the gross market rental per rentable m^2 per month recorded in the fourth quarter of 2003 for (i) stand-alone prime non-leaseback , (ii) prime industrial parks and (iii) stand-alone secondary industrial space of 1000 m^2 , located in primary and secondary industrial cities.

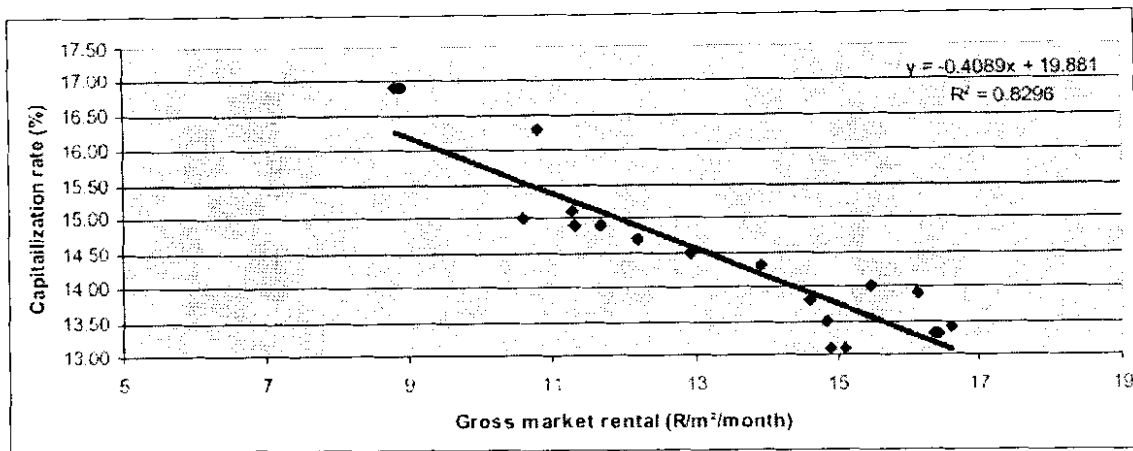


Figure 2.5 : Primary cities: industrial cap rate vs gross market rental rate (source: Johnson & Vernooy, 2004).

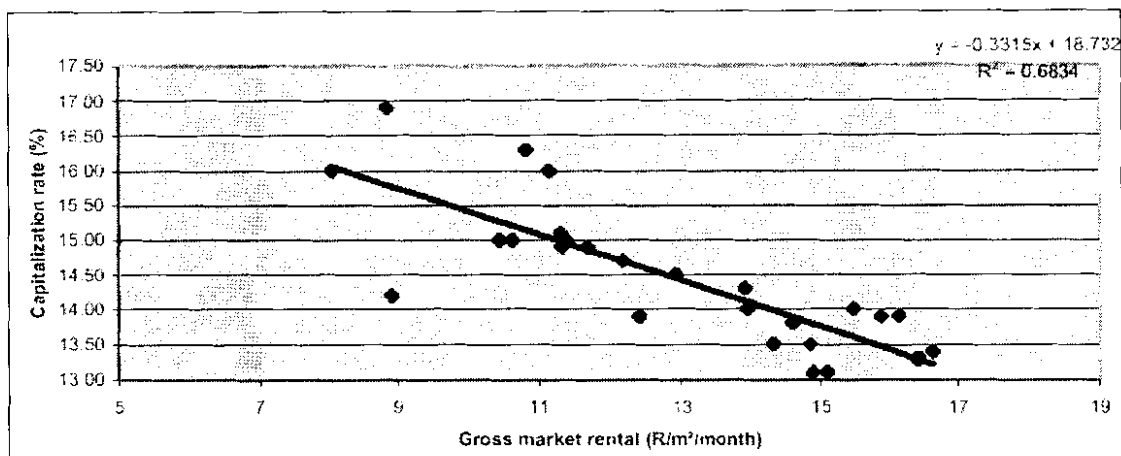


Figure 2.6 : Secondary cities: industrial cap rate vs gross market rental rate (source: Johnson & Vernooy, 2004).

The equation is likely to yield unreliable results for gross market rental rates that fall much outside the range R8m²/month to R17/m²/month. An example to demonstrate the application of the above: If the gross industrial rental for a 1000m² building, located in a primary or secondary industrial city, is R10 per rentable m² per month, then the capitalization rate is: industrial cap rate % = $18.732 - (0.3315 \cdot 10) = 15.4\%$

Johnson and Vernooy (2004) thus found a 0.4% point difference between the industrial capitalization rates generated by the primary city and secondary city industrial capitalization rate equations.

2.7.5.3. R & A's shopping (retail) centre equation

Johnson & Vernooy (2004) follow a similar methodology to devise the equation for the Shopping (retail) centre capitalization rate. The equation is as follows (descriptive statistics for 12 observations are: correlation coefficient $r = -0.88$, standard error = 0.56):

$$\text{Shopping centre capitalization rate \%} = 14.706 - (0.02 * \text{gross rental}),$$

where the shopping centre capitalization rate % equals the capitalization rate applicable to the fourth quarter of 2003. Gross rental is defined as the gross market rental rate per m^2 per month in the fourth quarter of 2003 for a shop of 100m^2 within the centre. This equation is valid only for gross market rentals that are within the range of $\text{R}40$ to $\text{R}185/\text{m}^2/\text{month}$ for space of 100m^2 . Example: A gross market rental rate is $\text{R}150/\text{m}^2/\text{month}$ for space of 100m^2 of rentable area which yields a Shopping centre capitalization rate $\% = 14,706 - (0,02 * 150) = 11,7\%$.

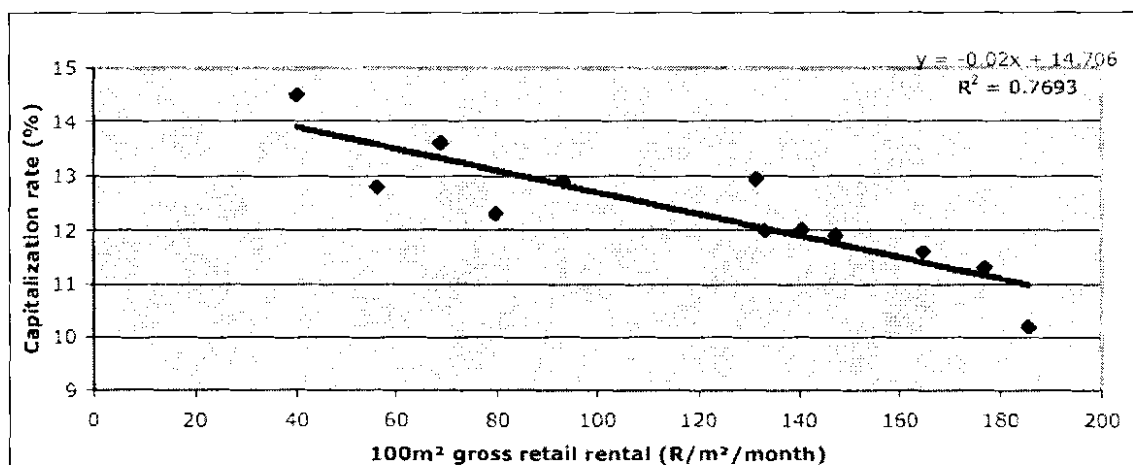


Figure 2.7 : Shopping centre cap rate vs. gross market rental rate (source: Johnson & Vernooy, 2004).

2.7.6. The influence of macro-economic risk on commercial real estate returns

Liow (2004:48) empirically investigated the behaviour over time of excess returns (risk premium) on commercial real estate in Singapore. Liow (2004:57) found specifically, that the office and retail real estate excess returns are related to five specified

macroeconomic factors. The author argued that the changes in demand and supply of commercial space are a result of changes in real economic activity. Consequently it should be expected that indicators of economic activity would provide indications of real estate activity (returns).

Liow's five indicators of economic activity that act as a joint proxy for a set of latent variables (reflecting an elaborate systematic risk premium comprising several components) that determine commercial real estate returns are:

1. Growth rate in gross domestic product, which is defined as the geometric mean difference between successive quarters' seasonally adjusted GDP. During periods of high economic growth, there is confidence within the economy and this would stimulate demand for products and services. Those firms seeking expansion would then require more commercial space. As an explanatory variable of returns, the growth in GDP is expected to have a positive (referring to the sign of the term) contribution on the total systematic risk premium for commercial real estate.
2. Growth rate in industrial production output, which is defined as the geometric mean difference between successive quarters' industrial output index, would similarly be related to an increase economic activity that have a positive influence on property returns (similar to GDP growth).
3. Inflation which tends to allow owners of real estate to raise nominal rents from one year to another. Further, increases in nominal rents generally mean that a higher net income stream is capitalized, meaning an increase in the building's market value. Liow argues that unexpected inflation is the relevant part of inflation that plays a role in returns of property. Unexpected inflation is that portion of inflation which was not expected from extrapolation of current levels of the CPI into the next period. Liow (2004: 56) calculated the unexpected inflation rate from regressing current level of inflation (CPI) onto one-quarter lagged inflation. The residuals from the regression are used as estimates for unexpected inflation.
4. Property returns could be influenced either positively or negatively depending on the degree to which the economic activity is lagging with respect to response in changes in short-term interest rate. Short-term interest rates are derived from the three-month holding period return to a Treasury bill.

5. The excess return (relative to the risk-free rate) on the Stock Exchange of Singapore (SGX)'s value weighted portfolio act as another systematic risk component that would make a positive contribution to property returns.

Liow (2004: 54) empirically established a positive excess return for all of the five variables for office and retail real state.

Ling and Naranjo (1998:14) also empirically investigated time-varying risk premiums and the influence of macroeconomic factors on the behavior of real estate returns and whether the respective factors are priced ex ante. The authors' study concluded with results that were consistent with those of Liow. In particular it was found that the growth rate in real per capita consumption, real Treasury bill rate, term structure of interest rates and unexpected inflation have systematic influences on commercial real estate returns.

Matysiak and Tsolacos (2003: 213) expressed a view that as interest rates increase the economy and property markets are deflated, that is, economic activity and property returns are stemmed. In such a case, rising (falling) interest rates would have a negative (positive) or declining effect on property returns. For example, the reason for a rise in interest rates by the Treasury could be to combat demand side inflation (amongst other factors). In the higher interest rate environment, the higher cost of debt discourages consumers to spend as much as before when the economy experienced an upswing. (During the upswing, consumers had more disposable income available when interest rates and taxes were lower in order to stimulate economic growth). Next, as economic activity declines, the tenants (e.g. shop owner) leasing a shop in a retail building would experience lower revenue from goods or services as consumers spend less.

Shop owners (the tenants) can soon no longer afford the market related rent (that was devised from market fundamental supply and demand factors while the economy was still buoyant) charged by the property owner. The tenants are forced to vacate the commercial space in order to find a more affordable space elsewhere. All else being equal, the *property owner* would consequently experience a lower rental income due to the increase in vacancy rate and consequently the return from the specific property in

total would decline. It can thus be seen that in this example increasing interest rates could have a negative effect on property returns.

On the contrary, given the lagged response of the economic cycle to interest rate changes, interest rates and the broad economy could in some cases appear to be co-moving (in the same direction). Due to the lag, a positive contribution from interest rates to real estate returns could be devised in such a case. An empirical investigation by Matysiak and Tsolacos (2003: 217) showed that interest rates (the Treasury Bill rate and the yield on 20-year gilts) have statistically significant predictive power for office and industrial rents. The authors also found that the volume of retail sales (an indicator of economic activity) has significant explanatory power in predicting industrial property returns.

2.8. Conclusions from the literature review

The following are being concluded from the literature review:

1. Investors have a choice to hold property either directly or indirectly. Directly held real estate is often not within the financial reach of the beginner or average investor due to the large capital layout and/or high level of involvement with the management of the property. Indirectly or passively held commercial property is an investment vehicle that can more easily provide access to the property market for a beginner or less affluent investor.
2. Modern portfolio theories such as the CAPM and APT appear to be incomplete with regard to describing returns on real estate. Therefore, five alternative frameworks were reviewed and Table 2.2 shows the important characteristics of the five models. These frameworks build on the basic premise of the CAPM and APT but are expanded specifically for real estate. The essence of these frameworks are that an investment in commercial property is similar to an investment in most other asset classes with respect to the fact that investors require compensation for risk borne by undertaking the investment. For example, property has historically delivered returns between long bonds and stocks. Firstly, long government bonds can be considered a benchmark for the risk-free rate for a long-term investment such as property. Due to, for example, illiquidity,

indivisibility, demographics and location (for example, a property that becomes difficult to sell due to an aging location) property is a more risky asset than long bonds. Investors require compensation in the form of higher returns for assuming these risks and thus the required return on property is higher than long government bonds. Secondly, stocks' required returns are higher than property's required returns since stocks are more risky investments than property. For example, investment risk in the stock market results from the stock market being subjected to change (increase) in interest rates. The degree of interest rate sensitivity is dependent on the asset structure, debt structure and dividend of the individual companies that are listed on the stock exchange. Mueller and Pauley (1995:324), observed that real estate assets are also exposed to interest rate risk but provide a better hedge against interest rate risk because of the more effective inflation hedging characteristics of real estate compared to general stocks. It follows that investors' required return on stock's are higher than property's required return since investors assume a larger risk with stocks with respect to for example interest rate risk.

3. Researchers such as Ibbotson et. al. (1984:31) further argue that real estate investors could seek compensation or additional premiums (over a risk free rate plus risk factors) for non-risk related factors such as marketing or information costs related to the trading of a property. However, in practice non-risk factors are difficult to quantify and investigate due to the scarcity of information related to non-risk factors since asset managers do not often keep record of such information.
4. Property returns will differ across nodes or locations and differences exist between returns achieved by respective property types in a specific node or location. For example, an investor can expect differences in returns between an office building held in Pretoria and an office building held in Cape Town. In Cape Town, the investor will not achieve the equal returns from office, retail and industrial types of properties. The investor will also be required to use distinct determinants for calculating returns for each property type that the investor owns in Cape Town.
5. The determinants of commercial real estate returns that were identified from the literature review are broadly categorised into two groups namely, economic variables (capital market and economic activity indicators) and commercial real

estate market fundamental variables. These determinants found in each group can have a structural (or long term) and/or cyclical (or shorter term, time-varying) influence, respectively, on commercial real estate returns (that is on income yield and growth). Also, there is no single variable that proxy single-handily for all possible risk factors such as the risk-free rate, the risk premium related to alternative investment opportunities on the stock exchange as well as economic risk, interest rate risk and market risk. Rather, a series of interdependent variables (structural or cyclic in nature) describe specific aspects of risk related to commercial property returns. Further, it can be concluded that the explanatory variables of commercial real estate returns found in the literature are by no means exhaustive.

6. Table 2.2 is a summary and interpretation of the theory encountered in the literature review. The last two columns on the right hand side of Table 2.2 provide the author's review of the relevance of the theories to real estate and specifically, to the SA real estate market context. It also includes a review of the potential application and relevance of the theory to this dissertation.
7. Table 2.3 below provides a definition, motivation and reasoning for selection of explanatory variables ($X_1 \dots X_n$) encountered in the literature review, of which the influence on commercial real estate returns will be investigated empirically. This table forms the starting point for the sample selection, the empirical investigation that follows and model building processes that will be pursued in Chapter 3.
8. It is often in this phase of the study, after the literature has been reviewed to gain understanding about a specific topic, that the researcher realizes that the research effort will be constrained by the availability of data. It is thus noted here that not all of the variables encountered in the literature review can be empirically tested due to, in some cases, the non-availability or non-reporting of information in the local property market. For example, the NET theory proposes that investor returns on real estate should be determined by additional, non-risk considerations. For example, costs related to finding an appropriate property, the costs of selling a property and a premium required to compensate an investor for locking up a large amount of capital per unit of real estate compared to the amount of capital locked-up in one unit of a stock. This type of information is not

readily reported or published by the property market and will thus not be included in the empirical investigation.

It should be noted here that the summary in Table 2.2 and Table 2.3, represents a partial outcome of the main objective of this study, namely to identify the explanatory variables of commercial property returns.

TABLE 2.2. CONCLUSIONS OF THE LITERATURE REVIEW AND DEDUCTIONS MADE FROM FRAMEWORKS OF RETURNS THAT WERE ENCOUNTERED

Model/ Theory for required return	Factors or determinants of return						Relevance to real estate returns	Relevance or applicability of the theory to South African real estate.
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6		
CAPM	k_{RF} or risk free rate	Beta					<ul style="list-style-type: none"> • CAPM is not appropriate to be applied directly to the real estate market since some of the CAPM assumptions are violated: • For example, real estate markets are not as efficient as the capital markets described by CAPM. Inefficiency derives from buyers and sellers that are not always aware of each other and the absence of a well-developed market (such as a "property exchange"). 	<ul style="list-style-type: none"> • The several multi-factor models that were reviewed potentially have more sound application potential than the CAPM, to real estate in SA. The author of the dissertation has the opinion that the premise of the CAPM that investors seek a return over and above k_{RF} could be extended to real estate in SA as well in a multi-variable model of return. This study will empirically investigate the significance

							<ul style="list-style-type: none"> • In addition, mispricing of real estate takes time to be corrected and investors in real estate often face cash constraints. • The CAPM is a single-explanatory factor model (besides constant k_{RF}). Mathematically, the CAPM might not be able to describe real estate returns as well as a multi-factor model. In view of the literature study, it's the opinion of the author of this dissertation that a multi-factor approach is required to describe returns in real estate. 	<p>of this premise to real estate in SA and specifically the long bond rate will serve as a proxy for the risk free rate.</p> <ul style="list-style-type: none"> • The choice of the long bond rate for the risk-free is appropriate for the following reasons: (1) Investment in real estate is regarded as a long duration investment. (2) Commercial real estate is relative illiquid and durable. (3) Long term bonds also capture long-term inflation expectations, are less volatile and less subject to market movements. • An investment in commercial property over a period of, say ten years, would be required to return
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								<p>at least the long-term government bond rate plus a risk premium, otherwise it would not be worth to bear the higher risk associated with the more risky investment in property (deduced from the CAPM). In view of these, it makes sense for long-term forecasts of commercial property returns that the most appropriate risk-free rate be derived from long-term government bonds.</p> <ul style="list-style-type: none">• Another motivation for selecting the long-bond rate as a determinant of commercial property returns investment is the fact that observed historic property returns on average, falls between
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								long-bond yield and equity returns on the stock exchange (Ibbotson & Siegel, 1984:225). This implies that property returns, long bond yields and the equity market returns should be mathematically dependent on each other.
APT	k_{RF} or risk free rate	b_{j1}	$b_{j2}..b_{jn}$					<ul style="list-style-type: none"> • The APT is not relevant for similar reasons (that is, inefficient markets) provided for the CAPM. • In addition, non-risk factors are not accounted for in the APT. • Further, the theory is still under development with respect to, for example, the determinants or betas responsible for describing return on assets in general. <ul style="list-style-type: none"> • Applicability to real estate in general is uncertain due to the theory still being under development. The development of the APT theory for application in real estate returns falls outside the scope of this dissertation. • The multi-factor approach of APT to describe investor returns as a function of financial and macroeconomic variables will be applied to

							<ul style="list-style-type: none"> • It is the opinion of the author of this dissertation that other, completed theories which were found in the literature review should rather be pursued in this study. 	<p>real estate returns in SA during the empirical study in this dissertation.</p>
NET	k _{RF} OR risk free rate	Beta (real estate)	Non-risk factors				<ul style="list-style-type: none"> • The NET builds on the basic premise of CAPM and APT. The NET in addition, accounts for non-risk factors such as information costs required to market a property. • NET also accounts for residual risk factors (remaining after diversification) such as opportunity cost and illiquidity premiums related to the indivisibility of real estate. • A further premium that NET account for is derived 	<ul style="list-style-type: none"> • The model was derived for a US context. The NET enumerates returns on real estate (and other assets) in terms of a risk-free rate as well as risk and not risk factors. The model emphasises especially the non-risk factors that contribute to required return and which could also be having an influence on returns in SA. • Conceptually it is a good model but due to lack of availability of information pertaining to non-risk

							<p>from the relative large amount of capital devoted to a parcel of real estate compared to the capital layout per individual unit of a security such as a stock. The risk derives from the fact that a real estate investor has a relative large exposure of capital per unit of real estate compared to one stock.</p> <ul style="list-style-type: none"> • The relative high capital layout in direct real estate investment also makes it difficult for an investor to participate in other investments. 	<p>factors, the model has limited applicability in general. In SA, the model is possibly less practical to implement due to even fewer information about non-risk factors being available and reported by the industry.</p>
IPD	Cap rate	Long bond yield	Gross market rental rate growth	Property specific risk factors such as vacancy			<ul style="list-style-type: none"> • Model is relevant to real estate returns but since statistical significance (for example, coefficient of variation, R^2), is not specified the model is thus 	<ul style="list-style-type: none"> • The concept of the long bond rate as a proxy for the risk free return is discussed in detail for the CAPM model above. • The IPD model is derived

				rate and/or tenants mix			<p>not well described.</p> <ul style="list-style-type: none"> • Cap rate as an explanatory variable is relevant since it provides an indication of income for the first year as a ratio of property value, assuming the property was let at market rental levels. • Market rental growth rate is a property market fundamental factor that appears to be a good proxy for growth in total returns. • Similarly, the vacancy rate is a useful explanatory variable of returns since it is derived directly from fundamental market information, namely the number of square meters not rented. 	<p>for SA properties and acknowledges that returns are different between property types and location.</p> <ul style="list-style-type: none"> • The description of the IPD model can be improved by defining statistical significance parameters such as R^2, as well as defining the relative weight of each dependant variable. • The model uses gross market rental growth, a property market fundamental determinant of return as well as economic determinants (related to the capital market) such as the long bond yield. • By including additional economical parameters
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								such as for example, the consumption per capita, the model could potentially be improved.
Ambrose and Nourse	k_{RF} or risk free rate	Cap rate	WACC and/or band of investment (cost of capital deployed in the property investment)	Inflation premium	Location and property type factors.	Average P/E ratio on SP500 that is an opportunity cost premium related to foregoing alternative investments on the stock exchange.	<ul style="list-style-type: none"> The Ambrose and Nourse's model is based on the principle that the so-called cap rate (refer to Glossary) is a major determinant of total return. The reason is that cap rate in essence expresses a ratio which is related to the return on an investment. (Cap rate express the ratio of net operating income, for the first year, derived from open market related rentals, before VAT and transfer duty, to the purchase price or the property.) The model further emphasizes difference⁴ in 	<ul style="list-style-type: none"> The relative strength of each of the determinants in the model is determined from US property return data that makes application of model irrelevant to the SA context. In addition, due to the differing macro economic setting of the US, the PE ratio of the SP500 do not necessarily present an alternative investment or opportunity cost for the SA investor. Further inflation in the US is different from the inflation rate in SA. The model is thus

							<p>returns among different property types and location.</p> <ul style="list-style-type: none"> The principle of using the P/E ratio as a relevant explanatory variable of property returns can be explained as follows: (1) Individual stocks and commercial real estate will have earnings/price ratios and rates of return, respectively, that reflect unique risk factors and anticipated future cash flows (from the property and business, respectively). (2) Changes in the business cycle and monetary market fluctuations will be reflected in both stock market and the real estate market. (3) Since investors 	<p>fundamentally not applicable to the SA context but the multifactor methodology could be useful for application to the SA context.</p> <ul style="list-style-type: none"> An important conclusion of the model is that property returns are dependent on macro economic variables (for example, inflation and interest rates). The contribution to real estate returns by these economic variables and others will be empirically investigated further in this dissertation using a range of economic variables from the SA context.
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							<p>will pursue the highest attainable returns for a specific risk level (according to the CAPM), lower yields on stocks for the same level of risk could drive these investors out of stocks to bonds and real estate that have expected higher return. (4) On the contrary, high yields may lure investors back to stocks. If both the stock and real estate markets are approximately efficient, very little delay should be observed between movements of investors' capital between the two markets.</p> <ul style="list-style-type: none">• Historically it has been observed that real estate have been delivering returns between bonds	
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							<p>and stocks and one would thus expect a close mathematical relationship between returns observed in these three asset types. The use of the P/E ratio is thus a good proxy for returns attainable from an alternative investment opportunity in the stock market.</p>	
Lee's Model	Intercept or k_{RF} or risk free rate term	Property type	Location	Random error term			<ul style="list-style-type: none"> • Firstly, the concept of the long bond rate as a proxy for the risk free return is discussed in detail for the CAPM model above. • The conclusion from Lee's model is that an investor should take cognisance of the difference in returns across property type and region (location). • The model uses factor analysis to enumerate 	<ul style="list-style-type: none"> • The model used UK property return data (1981 to 1995) and was optimised for UK properties but the methodology deployed can be applied to the SA context. • For SA properties, property type and location could play a major role, based on the conclusions made by Lee. This conclusion will

							<p>required return in terms of, an intercept (risk-free) term as well as property type and location terms. Primarily, according to Lee, property returns are driven by property type</p>	<p>guide the data and sample selection process in the rest of this study (chapter 3).</p>
R & A	Market rental rate in Rand / m ²	CAP rate					<ul style="list-style-type: none"> The model was specifically devised for real estate and expresses cap rate in terms of rental per m². The author of this dissertation believes that R & A's approach is sound. The reason is that the Rode model builds on the premise that an important source of income risk in properties (for which investors will demand compensation) is found in property market fundamentals such rental income per m² and 	<ul style="list-style-type: none"> The R & A single factor framework emphasises cap rate as an important determinant of the hurdle rate and describes cap rate as a function of market rental rate per square meter. The latter, according to R & A, is a proxy for value-determinants such as location, grade (quality of finishes and quality of facilities), tenant mix and vacancy. The R & A model express the cap rate for offices,

							<p>vacancy rate. The income risk derives from the uncertainty in demand (as driven by the market's economy) and supply (over- or under supply of property type in a specific area).</p>	<p>retail buildings and industrial sites for the main centra in South Africa. Rode's model reiterates that the investor should use distinct cap rate equations for the respective property types, region (node) as well as for the range covered by the market rental rate (expressed on a rand per square meter basis).</p> <ul style="list-style-type: none"> • R & A's assumption that market rental rate is a proxy for the combined contribution of several fundamental determinants of return, appears to be solid especially in view of the wide application amongst SA property practitioners. However, it is argued by the author of
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								<p>this dissertation that the coefficient of determination of between 68 % to 73% found by R & A could potentially be improved. This could in principle be achieved by introducing multiple factors in the model such as inflation, cost of alternative investments as proxied by the PE ratio of the JSE, retail sales figures etc.</p>
Liow et al	GDP growth	Industrial output	Un-anticipated inflation	Short term interest rates	Market portfolio returns		<ul style="list-style-type: none"> • The influence of macroeconomic variables on stock returns has been reported widely. Real estate has historically yielded returns between bonds and equities. Further, a degree of correlation or co-movement exists between returns on real estate and 	<ul style="list-style-type: none"> • It is concluded from this part of the literature study that the influences of the respective macroeconomic risk factors on the expected risk premium do vary across office and retail real estate. • The office and retail sectors thus do not behave uniformly as a single

							<p>return on other assets, it is anticipated that real estate returns are influenced by macro economic factors to some degree as well. (Ling and Naranjo, 1998:17).</p> <ul style="list-style-type: none"> • The rationale to use macro economic variables can be viewed as an attempt to capture business cycle effects, that is, systematic risks that are not diversifiable. Business cycles have an impact on prospective cash flows from rental and operational expenses in a systematic (non-diversifiable) manner for all properties across different geographic nodes. Using macro economic explanatory variables capture fundamental changes of 	<p>commercial real estate market within the economy. This implies that the study of the influence of the macro economic explanatory variables on returns, will have to be conducted separately for offices, industrial sites and retail sites in SA in this dissertation.</p> <ul style="list-style-type: none"> • Further, the studies by Liow and others have not exhausted the effect of all documented macroeconomic variables (e.g., the term structure of interest rate, consumption per capita, expenditure per capita, unemployment, etc.) on property market risk due mainly to lack of sufficiently long, historical data series. This leaves
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							<p>supply and demand in the economy that will influence demand and supply in the real estate market and consequently affect returns.</p> <ul style="list-style-type: none"> As with other assets, it can be concluded from the literature review that the respective economic variables have an interdependent influence on property returns. For example, during an upswing (that is, favourable macro economic conditions) businesses would increase capital expenditure to reap the benefits of the increase in consumer's demand. During this process, the demand by these businesses for commercial 	<p>room for further investigation in this dissertation of some of these variables.</p>
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space would increase to a point where owners of real estate could firstly, reduce vacancy rates and secondly, raise rent while construction (that would increase supply of commercial space) takes time to catch up.

- Another example of the effect of a macro economic factor such as inflation on property returns is as follows: In a period of relative low inflation (which is currently the case in SA), downward pressure is put on escalation of rental per square meter. Thus, lower returns compared to previously (in high inflationary environment) would result from a direct investment in an office

							<p>building.</p> <ul style="list-style-type: none">• In addition, the empirical study by Liow's (2004: 54) established that the estimated contribution of inflation to a set of real estate return data was significantly positive at the 1% level for both office and retail real estate. Hence, when the market is in equilibrium, commercial real estate is able to provide a strong hedge against the unexpected inflation. This implies that investors will under these conditions receive an excess return over inflation from a commercial property investment. Inflation thus appears to be an important determinant of real estate returns. In	
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						<p>this study the analysis of the effect of inflation could be refined by studying the effect of inflation reported for each of the metropolitan areas that corresponds to the commercial property nodes of Pretoria, Durban, Bloemfontein and Cape Town (as opposed to using the national CPI figures).</p> <ul style="list-style-type: none">• Finally, a case can be made that short-term interest rates, as a macro economic factor reflect anticipated changes in the economic activity (i.e. expansion or deflation) in the short run. A possible influence on real estate returns could be either positive or negative depending on the position of the economy in the economic cycle.	
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TABLE 2.3 Declaration, motivation and rationale for selection of explanatory variables

INDEPENDENT OR EXPLANATORY VARIABLES IN MULTIPLE REGRESSION ANALYSIS, $X_1...X_9$, FOR EACH TYPE OF PROPERTY AND NODE

SYMBOL	Definition	Anticipated effect/ Sign of coefficient	Rationale for selection
A. Risk Free rate (choose one of the following for model)			
$X_1 =$ BNDSST	Yield on 91 day SA Treasury bonds	Positive	<ul style="list-style-type: none"> Property should be regarded as a long-term investment, and for that reason, the long bond rate makes sense (see reason below for long bonds) to act as proxy for a risk-free rate of return. However, the explanatory power of the short bond rate will be determined as well. Short-term bonds capture short changes in the inflation and economic outlook. If a strong correlation had existed between short-term bonds and property returns, then investors rather would have regarded direct property as a more liquid investment, which is contrary to the findings of the literature review.
$X_1 =$ BNDS0_3	Yield on 0 to 5 year SA Government Bonds, which is the return paid by the government at maturity of the bonds	Positive	<ul style="list-style-type: none"> The long bond rate is an appropriate risk free rate for a long-term investment such as a property since it captures anticipation of long-term inflation and economic outlook.
$X_1 =$ BNDS3_5	Yield on 3 to 5 year SA Government	Positive	<ul style="list-style-type: none"> A higher (lower) long bond rate would increasingly (decreasingly)

	Bonds, which is the return paid by the government at maturity of the bonds		<p>offset investors' total return. Therefore, a positive coefficient is expected.</p> <ul style="list-style-type: none"> • Only one of the five types of bonds can be chosen as an explanatory variable or proxy for the risk-free rate to avoid double counting of the effect of the risk-free rate on property returns.
$X_1 =$ BNDS5_10	Yield on 5 to 10 year SA Government Bonds, which is the return paid by the government at maturity of the bonds	Positive	
$X_1 =$ BNDSGT10	Yield on 10 years and longer maturity, SA Government Bonds, which is the return paid by the government at maturity of the bonds	Positive	

B. Alternative investment opportunities

$X_2 =$ PE_JSE	Average P/E ratio on JSE for all classes of shares, which is the ratio of the price of a stock to the earnings or dividend paid.	Negative or positive	<ul style="list-style-type: none"> • Historically, according to US and EU research, property has yielded returns less than stocks. • In addition, according to the CAPM, investors will require a specific return at a specific risk level. In efficient markets, investors could thus switch between asset classes if the current asset underperforms at this level of risk. Thus if the stock exchange underperforms or yields lower returns than required at the level of risk, investors could freely switch to other assets such as property or bonds that perform better at the level of risk (or in the short run yields higher returns at a lower risk level).
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			<ul style="list-style-type: none"> • Under these conditions, it is anticipated that the returns of the JSE and SA property are mathematically related in a negative manner. • Under another set of conditions during a period where a lagged response of property and the JSE is observed relative to declining (inclining) economic conditions, a degree of co-movement could exist between property and the JSE. Under such a scenario, the total return on property and the P/E of the JSE could be positively related.
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C. Economic Variables

C1. Inflation

$X_3 = \text{NINFL}$	Metropolitan or nodal Inflation rate as calculated from the CPI data.	Positive	<ul style="list-style-type: none"> • A higher (lower) inflationary environment would allow property owners to increase (decrease) rent accordingly. Thus, total returns collected from the property would increase (all else being equal). • Another argument for including inflation rate as an explanatory variable is as follows: A higher (lower) inflation rate would increase (decrease) the (nominal) risk-free rate (as would be manifested in the long-bond rate) thus increasing (decreasing) expectations of total return.
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C2. Indicators of economic activity (choose one of the following for model)

$X_4 =$ CONSEXP	Percentage change in consumption	Positive	<ul style="list-style-type: none"> • Indicators of economic activity reflect the degree to which the
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	<p>expenditure by households.</p> <p>Definition: Spending on goods and services that are used for the direct satisfaction of individual or collective needs, as distinct from purchases for use in a productive process</p>		<p>local economy is expanding or contracting. Thus, these parameters reflect change in macro supply and demand of goods and services, which in turn will influence returns positively (negatively) during expansion (contraction) of the economy. Therefore, a positive coefficient is expected.</p>
X ₄ = DISPINC	Percentage change in disposable income per capita	Positive	<ul style="list-style-type: none"> • For example, during increase of economic activity, demand for office space would increase as more people are employed to cope with a venture's increased demand for its services. This would be leading to a decrease in vacancy experienced by a property owner for a specific property and result in increase in rental income or return from a specific office building. • A very important assumption pertaining to the handling of economic activity indicators as possible explanatory variables of returns is made as follows: Economic activity indicators are extracted from the SARB quarterly bulletin on a national (as opposed to a nodal) level. It is assumed that the indicators of economic activity will approximate expansion and contraction of economic activities on a nodal or regional level in each of the four property nodes.
X ₄ =RETSAL ES	Percentage change in retail sales	Positive	
X ₄ = ACDC	Percentage change in electric current generated by Eskom.	Positive	

			<ul style="list-style-type: none"> • A mathematical justification will be provided to indicate which economic activity indicator has the strongest explanatory influence on returns.
D. Property Market fundamental parameters			
D1. Income yield parameters (choose one of the following for model)			
$X_5 = \text{CAP}$	<p>Capitalisation rate or net operating income per annum as a fraction of the price paid for the property. Net operating income is calculated assuming that the property is fully let at open market rates.</p>	Negative	<ul style="list-style-type: none"> • Cap rate express some form of return on an investment since it incorporates a ratio of net rental income at market rates to value of the property. • A negative contribution by cap rate is expected. An explanation for this result could be that investors are paying high prices (which is implying a low cap rate used in the valuation or DCF analysis of the purchase price of the property) for properties that currently yield a high rent per square meter income. (see Figure 2.4 to 2.7 on pages 56 to 59) Since rent per square meter scales positively with total return, the cap rate is expected to have a negative contribution to total return.
$X_5 = \text{INY}$	<p>Initial yield, or the estimated net operating income for year 1, as a fraction of the price paid for the property. Thus, in contrast with the CAP rate, the INY is expressed as the</p>	Positive	<ul style="list-style-type: none"> • Initial yield express some form of return on an investment since it incorporates a ratio of expected net rental income to value of the property. It is thus anticipated that a positive relation exists between total return and initial yield. • It would not be logical to use both cap rate AND initial yield since

	ratio of the <i>realistic expectation</i> of net operating income (for the first year of ownership) to price paid for the property.		<p>under aggregated conditions these two parameters can strife towards each other. That is, in an equilibrium market, the anticipated net rent and market rent could be the same for a building, if the whole building is fully let at market rental rates.</p> <ul style="list-style-type: none"> • A mathematical justification will be provided which of cap rate or initial yield has the strongest explanatory influence on returns.
D2. Other property market fundamental parameters			
$X_6 = \text{VAC}$	Vacancy rate is the percentage space of a specific property that is not let and which is thus not contributing to rental income.	Negative	<ul style="list-style-type: none"> • Vacancy rate is a fundamental property market parameter that partially captures some of the standalone risk involved in owning a specific property. • Vacancy rates also reflect information about future growth prospects and tenancy risks since it indicates the difficulty of attracting a tenant and uncertainty of future income stream. • Since vacancy rate deprives an owner of income, a negative relation is anticipated between returns and vacancy rate.
$X_7 = \text{RM2}$	Rent per square meters, or the rate paid by a tenant per each square meter that is let.	Positive	<ul style="list-style-type: none"> • An important source of income risk in properties (for which investors will demand compensation) is found in property market fundamentals such rental income per m^2 and vacancy rate (see VAC). The income risk derives from the uncertainty in demand (as driven by the market's

			<p>economy) and uncertainty in supply (over- or under supply of property in a specific area).</p> <ul style="list-style-type: none"> • Increase (decrease) in the rate of rent collected per square meter would lead to an increase (decrease) in operating income from the property and thus an increase (decrease) in total return (all else being equal). Thus, a positive coefficient is expected for this term.
<p>$X_8 = \text{DRM2}$ (used instead of X_6 and X_7)</p>	<p>Diluted rent per square meters is a parameter defined by the author of this dissertation and which expresses an 'effective rent per square meter' obtained by a property owner. In defining this parameter, the author wants to investigate the explanatory power of a factor that incorporates two property market fundamental parameters namely rent per square meter and vacancy rate.</p> <p>The DRM2 is defined as: rent per square</p>	Negative	<ul style="list-style-type: none"> • This hypothetical parameter aims at making the reported rent per square meter more conservative (or realistic) by incorporating the fact that some space in the building is standing empty. • This factor effectively scales the rent per square meters down (dilute) if the building as a whole was not fully let, that is when a vacancy % ≥ 0 is recorded. A higher (lower or zero) degree of dilution of rent per square meter will then contribute to a lower (higher) total return. Thus, a negative coefficient is expected for this term. • In defining this parameter, it is not attempted to redefine the fundamentals parameters of the property market. However, by defining the DRM2, it is attempted to find a potential better correlation between rent per square meter, vacancy rate and

	<p>meters x { 1 - [(VAC %)/100]}.</p> <p>This parameter can thus not be used in the regression together with either X6 or X7 since it incorporates both these parameters.</p>		total return rate.
X ₉ = GRM2	Growth in rent per square meters, or the positive or negative change in rental income.	Negative	<ul style="list-style-type: none"> • All else being equal, investors will anticipate a higher income stream in a market characterised by high growth in rent, because of the anticipated higher income generated. The higher the expected growth, the more investors will be willing to pay for a current cash flow stream which will boost the value of a property (increase the denominator of return that is expressed as ratio between net income and price paid) and thus the lower the total return (and consequently the discount rate) Therefore, a negative relation or coefficient is anticipated. • Growth may exert a structural influence especially if the growth prospects of an area are affected by a change in infrastructure or the local economy. • Growth is also a cyclical driver of yields and could vary with changes in economic activity.

CHAPTER THREE: METHODOLOGY AND RESULTS OF DATA CAPTURING, DATA PROCESSING AND MODEL BUILDING

3.1. Introduction

In the literature review undertaken in chapter two, a set of explanatory variables of returns on commercial real estate were identified and the effect of each variable on real estate returns was clarified from a theoretical point of view. The variables were grouped into three main groups namely (i) capital market variables (bond yields and returns on the stock exchange), (ii) indicators of economic activity and metropolitan or nodal inflation rate and (iii) property market fundamental parameters (cap rate, initial yield, vacancy rate, rent per square meters, diluted rent per square meters and growth in rental).

The conclusions that were drawn from the theory will provide guidance for undertaking the empirical investigation in chapter three. The theory will be used together with mathematical (multiple regression) and statistical techniques in order to establish which of these parameters, from each group, are responsible for explaining returns on commercial property. More specifically, the purpose of this chapter is to empirically investigate and subsequently quantify the strength of the relevant explanatory variables in a multi-factor model that describes variations in returns on commercial real estate. In mathematical terms, the return in each node for each property type will be the dependent variable (or $Y_{property\ type, geographic\ node}$) and the explanatory variables are the independent variables ($X_1 \dots X_n$).

The methodology of this chapter is built on the premise that property returns can be described in terms of a multi-factor model that, due to the extended number of explanatory variables, improves the explanatory power of a single factor approach. The rationale for following a multi-factor approach to explaining returns on real estate is described as follows:

1. Rather than assuming that one (for example, the market risk premium that features in the CAPM theory) source of risk proxies for all systematic risks, multi-factor models assume several sources of systematic risk exist in the economy. It

is assumed that a large subset of assets (that includes real estate), respond to fluctuations in these factors.

2. Investors require compensation in the form of additional premiums for bearing the systematic risk associated with exposure to each of these factors.
3. The compensation or premium that investors receive for exposure to a particular source of risk is equal to the value of the specific risk variable, X_i , times the B_i coefficient or strength of the contribution, by each explanatory variable. In this chapter the optimum set of explanatory variables will be determined by firstly obtaining the simple regression coefficient between returns of a specific property type and node and the respective individual explanatory variables. Secondly, the degree of correlation between economic activity indicators will be used to eliminate double counting in this category of variables. The contribution or strength, B_i , by a specific explanatory variable to total return is determined by multiple regression analysis. Please refer to Appendix 3 for a description of the multiple regression technique and accompanying statistical significance tests of the results of such an analysis.
4. It is not claimed here that the explanatory variables that are studied capture all relevant economic or other non-diversifiable risks, but rather that these variables jointly proxy for a set of underlying variables or effects that determine real estate asset returns. The fact that these factors are jointly used to explain returns emphasise the findings in the literature review that there do not exist a single variable that explain returns on commercial real estate.

For the sake of clarity, Table 3.1 declares the symbols of the three respective dependent variables. Table 3.2 declares the symbols of each of the three categories of explanatory (independent) variables namely (i) capital market variables (bond yields and returns on the stock exchange), (ii) indicators of economic activity and metropolitan or nodal inflation rate and (iii) property market fundamental parameters (cap rate, initial yield, vacancy rate, rent per square meters, diluted rent per square meters and growth in rental). Each of these variables will be investigated empirically in order to quantify and select the optimal set of determinants for commercial property returns in SA. The justification for the selection of independent variables can be found in the concluding paragraphs of Chapter Two (Table 2.2 and Table 2.3).

TABLE 3.1 Declaration of the three respective dependent variables, namely returns on retail, office and industrial buildings

Dependant variable in multiple regression analysis, Y		
Respective Total return for three types of property		
$TRRET_{node}$	Total return on retail properties, which is calculated as the difference in income between consecutive years divided by the price paid for the property in the prior year	The returns on each property type will be regressed against the explanatory variables (independent) below, in each property node (Cape Town, Pretoria, Durban and Bloemfontein). The total return is the variable that one wants to explain in terms of a set of explanatory variables and therefore needs to be the dependent (Y) variable in the multiple regression analysis.
$TROFF_{node}$	Total return on office buildings. See definition for TRRET.	
$TRIND_{node}$	Total return on industrial properties. See definition for TRRET.	

TABLE 3.2: Declaration of symbols used for independent explanatory variables ($X_1...X_8$)

Abbreviation	Definition
A. Risk Free rate (choose one of the following for model)	
$X_1 = BNDSSST$	Yield on 91 day SA Government bonds
$X_1 = BNDS0_3$	Yield on 0 to 5 year SA Government Bonds
$X_1 = BNDS3_5$	Yield on 3 to 5 year SA Government Bonds
$X_1 = BNDS5_10$	Yield on 5 to 10 year SA Government Bonds
$X_1 = BNDSGT10$	Yield on 10 years and longer maturity
B. Alternative investment opportunities	
$X_2 = PE_JSE$	Average P/E ratio on JSE for all classes of shares

C. Economic Variables	
C1. Inflation	
$X_3 = \text{NINFL}$	Metropolitan or nodal Inflation rate as calculated from the CPI data.
C2. Indicators of economic activity (choose one of the following Indicators for model)	
$X_4 = \text{CONSEXP}$	Percentage change consumption expenditure by households
$X_4 = \text{DISPINC}$	Percentage change in disposable income per capita
$X_4 = \text{RETSALES}$	Percentage change in retail sales
$X_4 = \text{ACDC}$	Percentage change in electric current generated by Eskom
D. Property Market fundamental parameters	
D1. Income yield parameters (choose one of the following for model)	
$X_5 = \text{CAP}$	Capitalisation rate
$X_5 = \text{INY}$	Initial yield
D2. Other property market fundamental parameters	
$X_6 = \text{VAC}$	Vacancy rate
$X_7 = \text{RM2}$	Rent per square meters
$X_8 = \text{DRM2}$	Diluted rent per square meters (used instead of X_6 and X_7)
$X_9 = \text{GRM2}$	Growth in rent per square meters

3.2. Empirical methodology

The remainder of this chapter is organized around the description of the research methodology that culminated in a multi factor model of returns for commercial property nodes in South Africa. The results for each step are also presented. The methodology comprised the following steps:

Step 1: Description of sample selection processes, sources of data as well as characterization of data through inspection. The process will be involving the use of quantitative descriptive statistics.

Step 2: This step entails initial screening of the possible set of explanatory variables. *Simple regression coefficients* (R^2) will be calculated between each dependent variable, that is, Total return per node per property type ($Y_{property\ type,\ geographic\ node}$) and each of the individual independent explanatory variables ($X_1...X_3$) relevant to the node and property type.

Step 3: Model building using multiple regression and descriptive statistics. Calculation of the multi-factor explanatory model of commercial property return data with the multiple regression method using the optimum set of explanatory variables determined in step 2. The process will include determination of the coefficients or strength of contribution by each explanatory variable.

3.2.1. Step 1: Description of data samples and sampling process

This section describes the data samples and sampling process that were used in the empirical study. The premise of using a sample as opposed to the entire population (which is rarely available to the researcher) is built on the following principle: If a sufficient large or representative sample is selected appropriately, it can provide the desired degree of accuracy without the necessity of testing the whole population (Wisniewski, 2002: 195). In other words, if the entire population of data is not readily available, then the well-selected and representative sample could be regarded as statistically and mathematically behaving in the same manner as the population.

The sample data used in this study have been acquired from a number of sources. The characteristics of the respective databases and sources of data are discussed in this section. The data (and simple regression coefficients which is dealt with in Step 2 below) are tabulated in matrix format in Appendix 1.

1. Commercial property financial performance data

The commercial property market data (Investment Property Databank, 2005) were obtained from the Investment Property Databank (IPD), which was established in 1997 for SA commercial properties. The IPD tracks financial performance of commercial property in a number of countries including South Africa (SA), United Kingdom and Euroland. In case of the SA IPD database, the time series of each type of performance measurement was compiled from 21 portfolios (including those of the four largest investors in the South African market) covering 2232 properties with a total market value of R74.7bn. Each property performance has been measured using a common approach to valuation in accordance with the SAPOA/IPD guidelines.

The data sample of this study spans the period 1995 to 2004. The data sample pertains to performance of three types of properties namely, office buildings, industrial sites and retail sites. Specifically, the following data were extracted for each type of property in each of the four nodes (see below): the total return (that is, the sum of income yield and capital growth), cap rate, initial yield, rent per square meter, rent growth rate and vacancy rate. IPD calculates these parameters as an average over three months and then compound it annually. *A very important assumption is made at this point of the study: It is assumed that the reported (aggregate) data of observed property returns approximate the investor's required rate of return. Since property data is aggregated over a number of properties in each node, some of the inefficiency in the property market that results in individual properties trading for longer periods at prices above or below the level that matches the specific level of risk, is diluted or mathematically reduced. The return per annum per property type and node thus on average approximates the investor's required return. In other words, property returns, in the aggregated data set approaches the return that property investors require at the specific level of risk.*

The property data were extracted for the following commercial property nodes: Pretoria, Bloemfontein, Durban and Cape Town (see Table 3.3 on the next page). The reason other nodes were not included in the analysis is that the

chosen sample contains the most complete (uninterrupted) time series of property performance data across the widest range of property market variables for a period of ten years (in some cases, nine years). (This is with the exception of Bloemfontein, which do not have total return data for industrial properties and Pretoria, which do not have a set of cap rate data for industrial sites. For this reason, industrial property returns for Bloemfontein will not be studied and the influence of cap rate is excluded for industrial properties in Pretoria.) Table 3.3 below shows the number of properties in each node for each class or type of property. It can be seen that on average the sample size of the Bloemfontein node is small in terms of number of properties for which performance measures are reported.

IPD data base characteristics: Number of respective types of properties in a specific node												
	Cape Town			Pretoria			Durban			Bloemfontein		
	Retail	Office	Industrial	Retail	Office	Industrial	Retail	Office	Industrial	Retail	Office	Industrial
1995	48	52	96	21	59	11	27	37	52	8	5	3
1996	52	59	82	22	67	10	27	41	45	9	6	3
1997	51	54	75	22	67	10	25	38	44	8	7	1
1998	49	60	85	33	88	17	36	46	103	7	8	1
1999	45	63	67	28	86	17	38	57	95	7	9	1
2000	56	67	65	30	93	18	45	63	94	8	11	1
2001	50	57	56	28	74	18	40	54	92	6	8	1
2002	43	47	58	27	61	16	32	48	98	5	8	3
2003	62	85	86	20	62	20	31	57	101	3	8	4
2004	56	87	81	27	73	13	25	55	97	4	4	1

Table 3.3: Sample size or Number of respective types of properties in a specific node. (source:own).

Figure 3.1 to Figure 3.4 below, show the time series of total return for the four nodes under investigation in this study, namely Bloemfontein, Durban, Pretoria and Cape Town. As expected from the literature survey, both cyclic (short-term swings indicated by up or down curving arrows) and structural (long term downward trends indicated by a straight, downward sloping arrow) components are present in the behaviour of total property returns. Examples of cyclic determinants of returns would be vacancy rate. Examples of structural

determinants of returns would be the long bond (risk free rate). Cyclic and structural trends are related to changes observed in the business cycle indicators (for example, consumption and retail sales) and underlying long-term changes in the economy (for example, as manifested in long-bond rate).

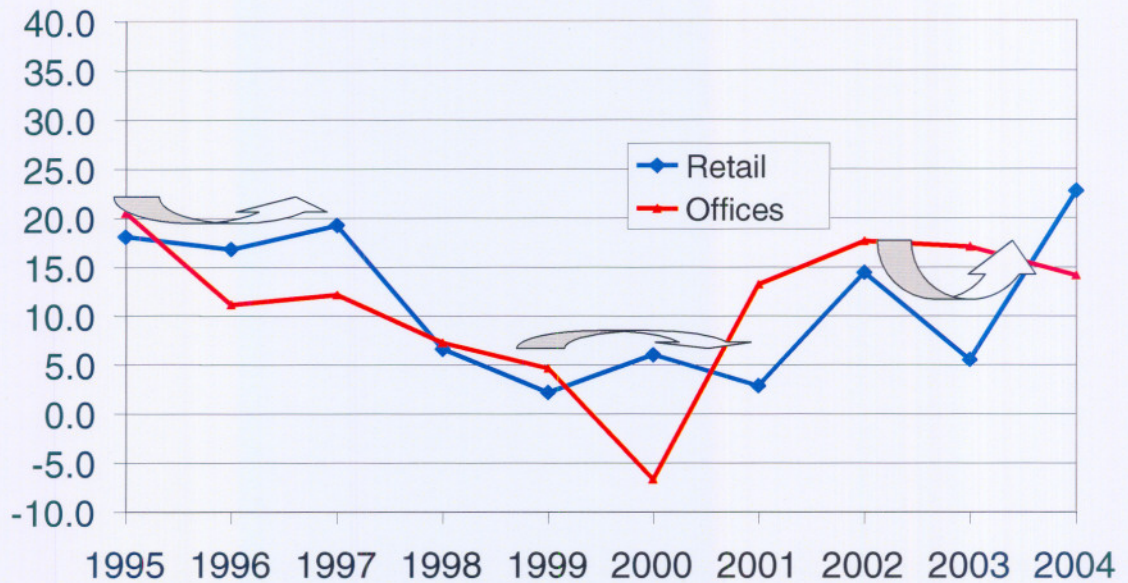


Figure 3.1: Time series of total returns for retail and offices sites in Bloemfontein (source: own, compiled from IPD data).

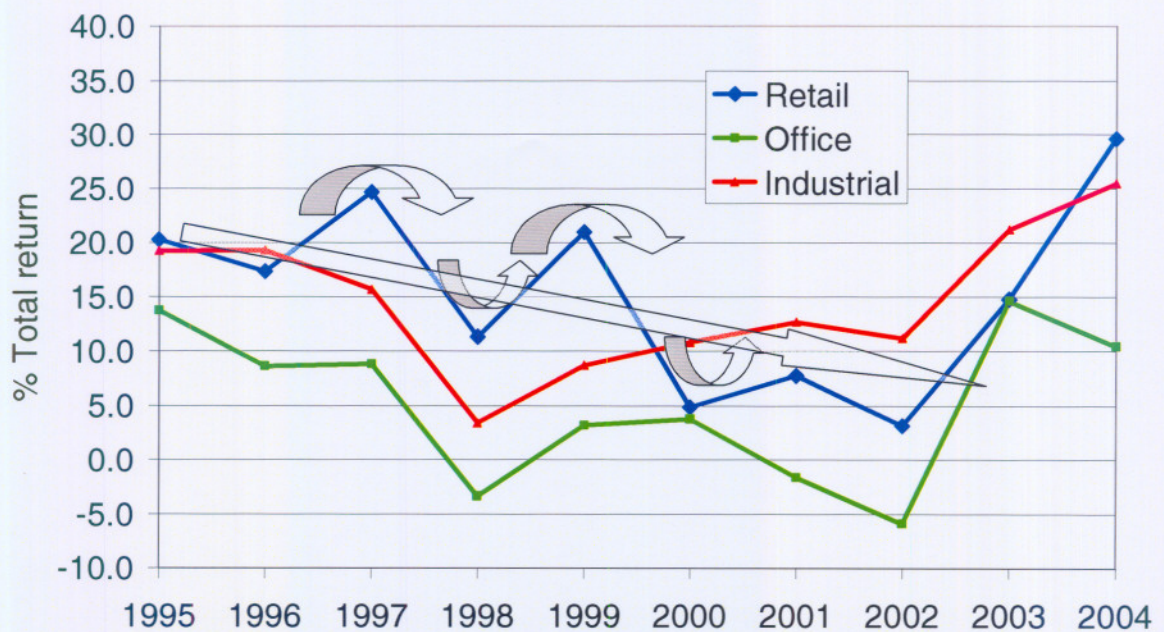


Figure 3.2: Time series of total returns for retail, office and industrial sites in Durban (source: own, compiled from IPD data).

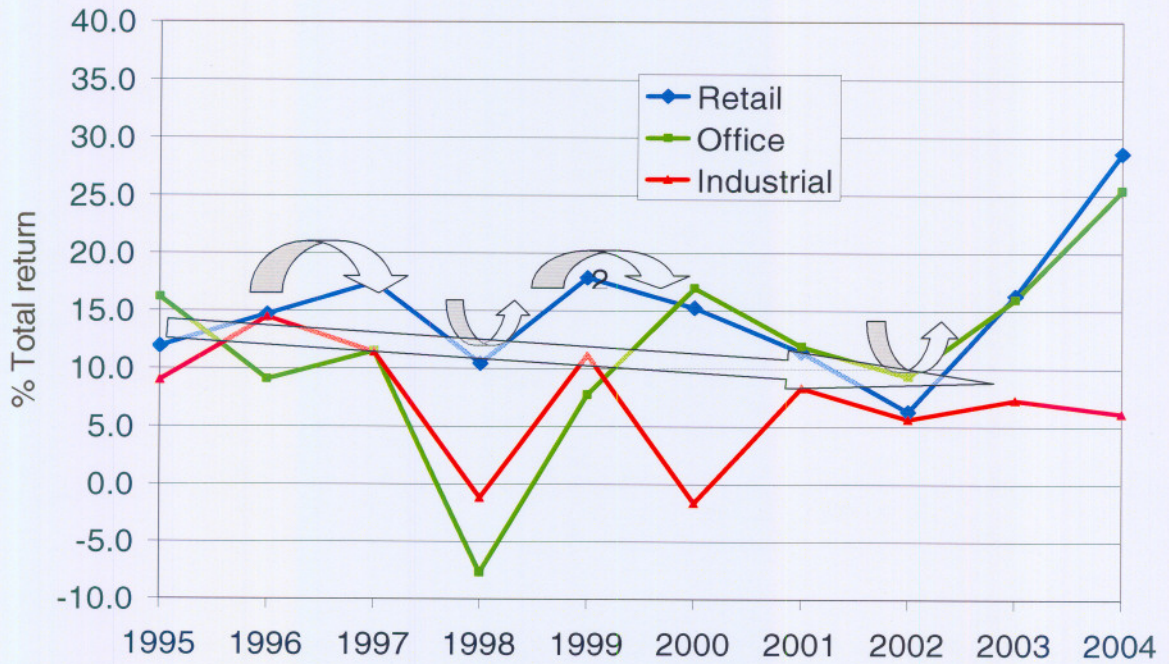


Figure 3.3: Time series of total returns for retail, office and industrial sites in Pretoria. (source: own, compiled from IPD data).

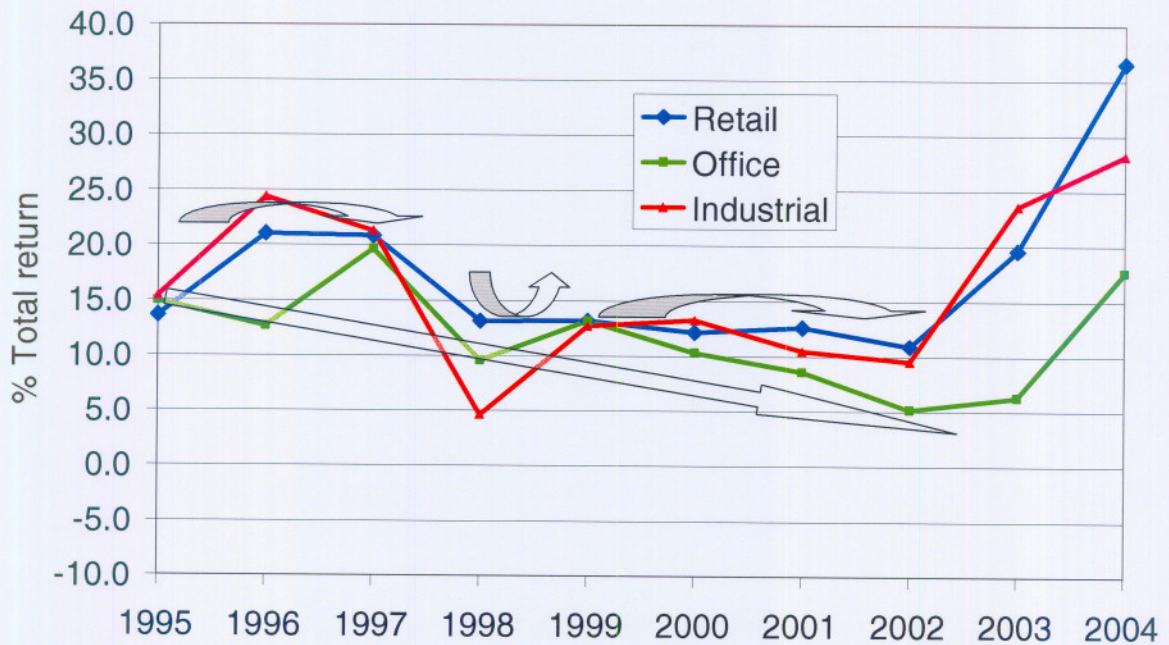


Figure 3.4: Time series of total returns for retail, office and industrial sites in Cape Town. (source: own, compiled from IPD data)

In view of the myriad descriptive statistical measures available, it is easy to be sidetracked in this phase of the empirical study and to proceed by describing all the above-mentioned samples of commercial property performance data in terms

of every single statistical measure available. This approach will be avoided here since such an elaborate analysis is not as relevant to the study as the statistical significance analysis, that will be performed during the model-building phase when the parameters are integrated into a multi-factor model. Rather, in this section, the sample description (analysis) will be confined to statistical description of the variation of total returns on commercial property in the main SA geographical nodes. Specific attention will be given to the Coefficient of Variation (CV), which is a useful measure to describe the selected sample of property returns since it combines two descriptive statistics measures, namely standard deviation and mean. Further, the CV is useful to compare the standalone risk per unit of return for a specific property type in one node to another (of the same type in a different node).

Table 3.4 below summarises the mean, standard deviation, coefficient of variation and minimum and maximum values of return found for the respective property types and nodes (location) as well as nationally. Figure 3.5 shows the premium obtained on Nodal Total Average Return per Property type (between Y1995 to Y2004) relative to National Total Average Return per Property type (between Y1995 to Y2004). It should be noted that on presentation of this result, an important secondary objective of this study is achieved.

	Total Return All Property Nodes				Cape Town			Pretoria			Durban			Bloemfontein		
	All property	Retail	Office	Industrial	Retail	Office	Industrial	Retail	Office	Industrial	Retail	Office	Industrial	Retail	Office	Industrial
Min	5.0	9.0	1.4	2.1	10.9	5.2	4.6	6.3	-7.7	-1.6	3.2	-5.9	3.4	2.2	-6.7	n/a
Max	23.4	26.1	16.7	24.4	36.5	19.7	28.2	28.6	25.4	14.5	29.6	14.6	25.4	22.8	20.5	n/a
MEAN	13.5	16.1	10.0	12.4	17.4	11.8	16.4	15.0	11.7	7.1	15.5	5.2	14.8	11.5	11.1	n/a
SD	5.0	5.5	4.6	6.8	7.7	4.7	7.6	6.0	8.6	5.2	8.7	7.2	6.6	7.6	7.8	n/a
CV	0.37	0.34	0.46	0.55	0.44	0.40	0.47	0.40	0.73	0.73	0.56	1.37	0.45	0.66	0.71	n/a
Premium *		2.58	-3.56	-1.15	1.30	1.85	4.00	-1.05	1.71	-5.28	-0.60	-4.71	2.41	-4.62	1.17	n/a

* See next page for an example of how this number was calculated

Table 3.4: Selected descriptive statistics for total return per property type and node. (source:own).

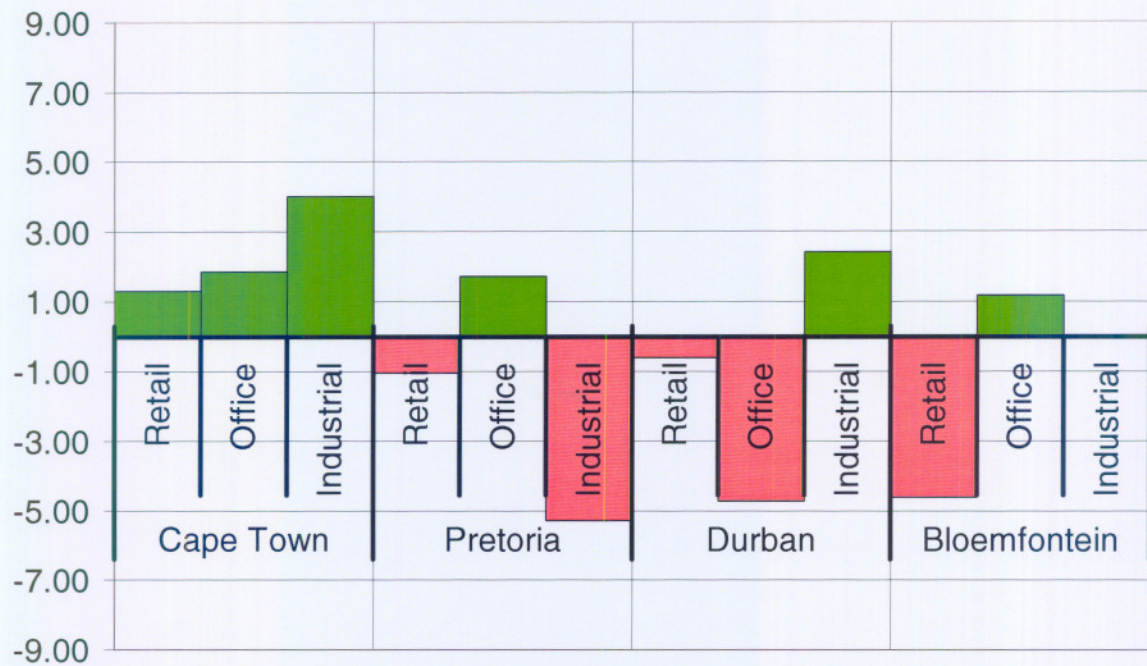


Figure 3.5: Premium obtained on Nodal Total Average Return per Property type (between Y1995 to Y2004) relative to National Total Average Return per Property type (between Y1995 to Y2004) (source: own, compiled from IPD, 2004).

From inspection of Table 3.4 and Figure 3.5 the following can be concluded:

1. Retail properties in all nodes yielded the highest average return of all property types and yielded a return of 2.58% (16.1% - 13.5%) above the sample of all property types in all nodes. Based on property type alone, an investor would therefore select retail buildings as an investment. Cape Town, as a geographic node yielded the highest average return amongst all three property types. In Cape Town, Retail sites, Office buildings and Industrial sites yielded 1.3%, 1.85% and 4.0%, respectively above the national average (all nodes) for the respective property types. Based on nodal returns alone, an investor would select Cape Town as the favourable geographic node for property investment.
2. The lowest total return observed in the sample is -7.7% (1998) for offices in Pretoria.
3. The highest total return observed in the sample is 36.5% (2004) for retail properties in Cape Town.

4. Retail sites, Office building and Industrial sites in Cape Town, Office buildings in Pretoria, Industrial sites in Durban and Office buildings in Bloemfontein, respectively all yielded a premium of between 1.17% and 4.00% above the national average return for each of these respective property types and geographic nodes. (For example, Bloemfontein Offices: $11.17\% - 10.0\% = 1.17\%$ and Cape Town Industrials: $16.4\% - 12.4\% = 4.00\%$) The remaining properties and nodes all traded at a premium below the national average. If an investor only had to consider those properties that trade at a premium above the national (all node) property type and nodal returns, then that investor would choose the group of property types and locations mentioned in the first sentence of this paragraph.
5. The assessment of the CV could assist an investor to quantify the risk per unit return in the standalone sense of, for example, an office building in Cape Town. The highest CV (= 1.37 or 137%) amongst all property types and nodes was recorded for offices in Durban (compare with the CV of all Offices properties of 0.46 or 46%). It can be concluded that this node and property type combination have a high associated risk per unit of return, when an investor would consider risk from a standalone perspective.
6. The lowest value of the CV (0.4 or 40%) amongst all property types and nodes for the sample was recorded jointly for offices in Cape Town and retail properties in Pretoria. (The national CV for all offices is 0.46 or 46%). That is, in the sample, these two nodes have the lowest overall standalone risk per unit return as measured by the CV. If an investor thus had to choose a direct property investment from the sample, the rational investor would prefer to hold an investment in either an Office building in Cape Town or a retail property in Pretoria, if the only consideration was the standalone risk.
7. It can further be concluded from all of the above that the rational investor in direct property that would be considering risk on a standalone basis and whom also had a choice amongst different locations (nodes) and property types, would chose specifically Office buildings in Cape Town as an investment.

3. Capital market data

a. Bond yields

For the purpose of the discussion below, short-term government bonds are defined as 91 days/ Treasury bills and 0 to 3 year maturity SA Government bonds. Long-term bonds yields are taken as the yields reported for 3 to 5 year maturity, 10 years maturity and over 10 years maturity SA government bonds.

The theory postulates that property investors use the long-bond rate as the risk free rate for capital budgeting (for example, the process of determining cost of capital) and required return calculations since property is a long term investment and long-bonds reflects long term outlook in the economy. Short-term bonds are subjected to too much short-term volatility in the economy and are not anticipated to be related to property returns from theoretical considerations discussed in chapter two. Therefore, not much attention will be given to the statistical description of 91-day bonds.

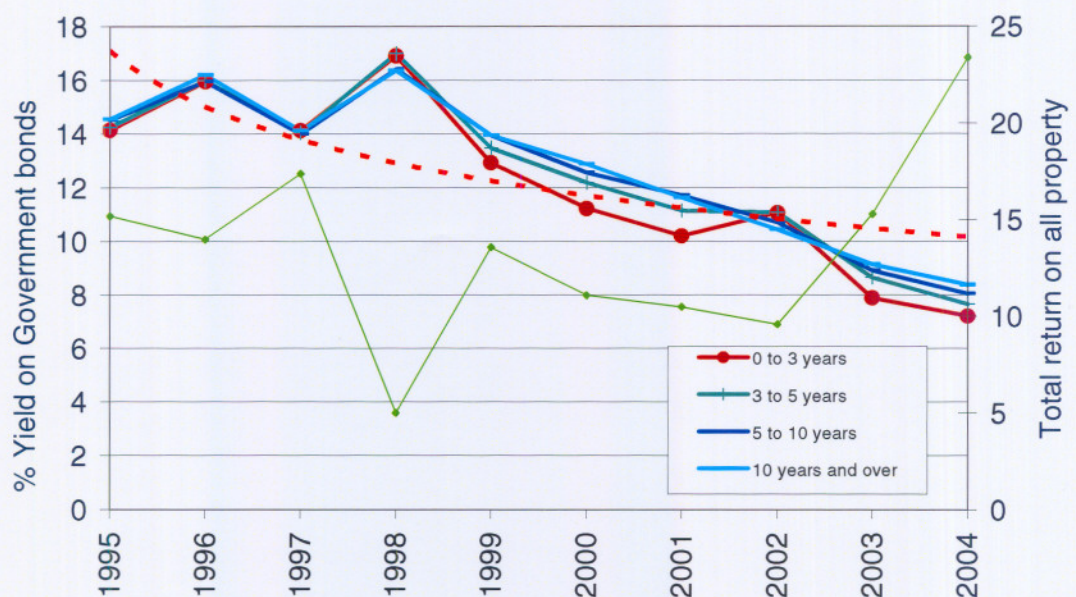


Figure 3.6: Time series of SA Government long-bond yields (annual yields calculated from averaging the monthly figures) and Total return on all commercial property. (% Returns on vertical axis vs. Time on horizontal axis. LOG fit is shown by red broken line to indicate structural trend in yield) (Source: compiled by the author from time series data obtained from SARB Dec-02 and Sep-05 quarterly bulletins).

Yields on government bonds were extracted from the 'Capital market' section of the December 2002 (South African Reserve Bank, 2002) and September 2005 (South African Reserve Bank, 2005) quarterly bulletins of the South Africa Reserve Bank (SARB) as well as the Statistics South Africa's web-based queries. It is important here to note that the SARB bulletins report bond yields on a monthly basis. The statistical mean yield per annum was calculated from the bond yield data that are published on a monthly basis during the period 1995 to 2004 in order to directly compare the bond yields with the annual property returns reported in the IPD database.

When using bond yields as a proxy for the risk free rate, the investor should take cognizance of the long-term trend of bond yields and consequently the structural effect introduced by (especially) using the long-term government bond rate. Figure 3.6 demonstrates this phenomenon and shows the time series of bond yields and total return of the sample comprising all 2232 properties of the IPD database. In Figure 3.6, the red broken line is a logarithmic fit for the yield of 3 to 5 year bonds, which is similar fit also to the trend observed for yields of the 0 to 3 year, 5 to 10 year and longer than 10 years-maturity government bonds. Figure 3.6 shows a long term decline in the bond yield for all four maturity periods. The decline is consistent with the lower inflationary economic environment and declining interest rates observed in the past ten years. The decline in long bond yields will influence the view of the risk-free rate by investors in commercial real estate in a downward direction. This in turn lowers the discount rate or required rate of return. What is interesting is that only in Y2003 and Y2004, properties yields exceeded returns of bonds. The observation that government bonds performed better than property for 8 years of the 10 year period (1995 to 2004) appears to be in violation of the principles of the CAPM. (According to the CAPM riskier investments such as property is requiring a higher return than bonds, but the opposite is found here.)

b. Average P/E ratio of JSE

The average P/E ratios on an annual basis from 1995 to 2004 for all classes of shares on the JSE were obtained from the December 2002 (South African Reserve Bank, 2002) and September 2005 SARB quarterly bulletins (South African Reserve Bank, 2005). Figure 3.7 shows the time series of the P/E ratio of the JSE and Total returns on all classes of commercial property in SA. From inspection it can be seen that these two parameters are negatively correlated, that is, on average a peak in the P/E ratio is associated with a trough (or drop) in Total return on commercial property. This is consistent with the conclusions from the literature review that observed the differences in returns in stocks and real estate at a specific time in the economic cycle. It was found that the differences in returns exist due to lagged response to change in economic activity of stocks relative to property. The implication for this dissertation is that investors can switch between for example equities and property freely (assuming efficient markets) and pursue the highest returns available between the two asset classes (at a specific level of risk). From this observation, a dependency or at least a relation of property returns on the P/E ratio of the stock exchange is thus anticipated.

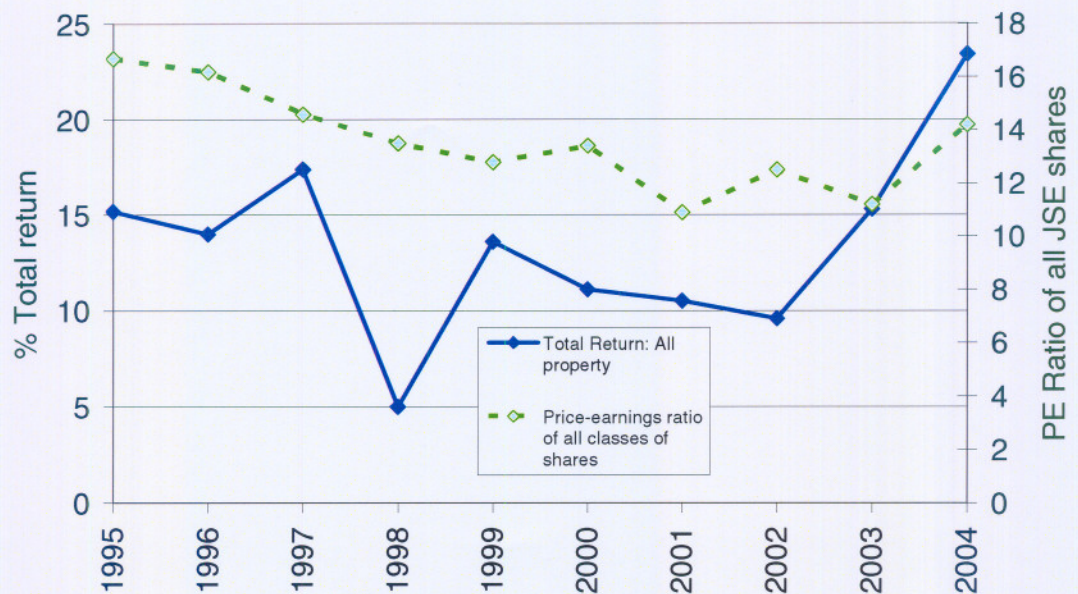


Figure 3.7: Time series of the P/E ratio of the JSE and Total returns on all classes of commercial property in SA. (Source: own, compiled from time series data obtained from SARB Dec-02 and Sep-05 quarterly bulletins).

3. Macro-economic data

a. Consumer Price Index (CPI)

The national as well as nodal (that is, metropolitan areas of Pretoria, Durban, Cape Town and Bloemfontein), CPI data were obtained from the web query on the Statistics South Africa website (Statistics South Africa, 2005). Since the empirical investigation is done on a nodal and property type level, the nodal inflation rate is used in the multiple regression analysis. It is assumed here that it would be more correct to express return of a specific property in a specific node in terms of the nodal or metropolitan inflation rate as opposed to the national inflation rate. The reason is that in a specific node the changes in the economic price levels of goods or services and changes in property fundamentals such as rental rate per square meter will be better described by local changes in the inflation rate than by variation in the national inflation rate.

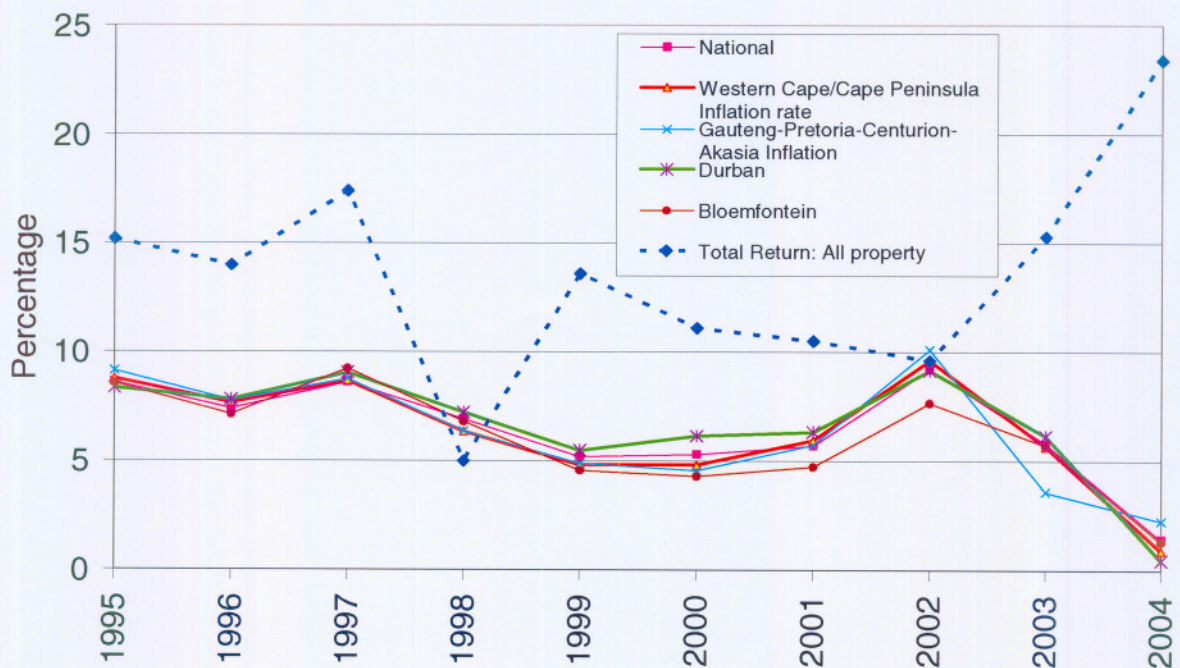


Figure 3.8: Time series of national and nodal inflation rate and total return on all commercial property from 1995 to 2004. (Source: own, compiled from Statistics South Africa (2005)).

Figure 3.8 above shows the cyclic nature of inflation rate for the period 1995 to 2002, while an apparent structural decrease (long term downward trend) has occurred (a view that is based on inspection of Figure 3.8 and which is consistent with the long trend observed for bonds in Figure 3.6) during the period 2002 to 2004. Further, the Durban nodal inflation rate appears to be higher relative to the national as well as other nodal rates during the period 1997 to 2003. During the period 1995 to 1999, a relative strong co-movement between inflation and total return on all property is observed. That is, all else being equal, when inflation increased (decreased), the investors' return on commercial property also increased (decreased). In this period, inflation appears to have had a strong influence on (or correlation with) returns. This is expected since for example, a property owner will increase rent as inflation increases. On the contrary, when inflation is lower (all else being equal), owners of property will experience a drop in demand for space if rent per square meter is increased at rates that are out of pace with the rate of inflation. Thus, it can be expected that the inflation rate influence rental income and consequently that returns on property and the inflation rate be correlated.

Nevertheless, during the period 1999 to 2004, a negative correlation (movement in opposing directions) between inflation (national and nodal) and total return on all commercial property is evident from inspection of Figure 3.8. That is, during this period, when inflation is increasing (decreasing), property returns were diminishing (increasing). It is speculated here that Y1999 to Y2004, when inflation was on average declining towards a lower average, other economic factors excluded from the analysis and scope of this study could have played a more important role for determining returns. The role of these factors would be to change the demand side of property market, which in turn drove returns up. In the lower inflationary environment together with the view that SA is seen as a more open and emerging economy, the expected influence of inflation appears to have diminished during this period.

The additional interrelated economic factors that started to play a more *prominent or even overriding* (over inflation) role could have included:

- i. Increased openness of economy,
- ii. Influence of the change in SA monetary policy that increasingly focus on expansionary budget activities such as increased public spending that in turn influence both supply and demand of commercial property by business that utilise these opportunities,
- iii. Increasing flow of capital to SA due to perceptions by international community that SA is less prone to terrorism and that SA presents increasing opportunities for expansion by foreign firms. This would increase demand for commercial space, decrease vacancy and increase returns (through increase in income) generated for a property owner; and,
- iv. It is therefore speculated here that these factors surpassed or overrode the influence of inflation on returns that was anticipated from the theory.

3. Indicators of economic activity

It suffices to conclude from the literature review that a multitude of indicators of economic activity have been linked to property returns. The indicators of economic activity in South Africa were extracted from the December 2002 (South African Reserve Bank, 2002) and September 2005 (South African Reserve Bank, 2005) quarterly bulletins of the SARB. These indicators were selected on basis of the availability of the data and the fact that these indicators all proxy for changes in economic activity (according to literature review). The indicators of the prevailing state of the economy for which the influence on commercial property returns will be empirically investigated in this study include:

- i. Percentage (%) change in final consumption expenditure by households,
- ii. Percentage (%) change in disposable income per capita,
- iii. Percentage change in retail sales (which was derived from year-on-year changes in the retail sales index); and,
- iv. Percentage (%) change in electric current generated by Eskom (which was also derived from the index values).

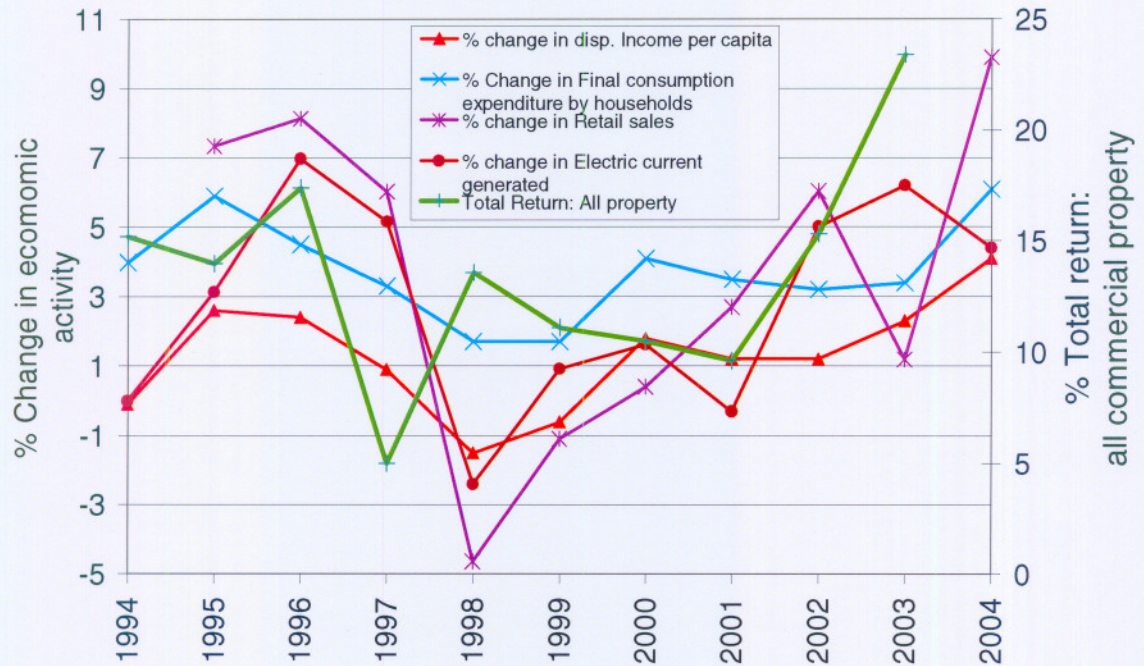


Figure 3.9: Time series of indicators of economic activity as reported by the SARB (primary axis) and % Total return on all commercial property (secondary axis) from 1995 to 2004. (Source: own, compiled from time series data obtained from SARB Dec-02 and Sep-05 quarterly bulletins).

The index data for retail sales and electricity generated use the base year 2000 (= 100). The indices were reworked by the author of this dissertation to express changes between consecutive years as a percentage in order to be comparable to the property returns that are reported on a per annum basis. Inspection of Figure 3.9 shows that on average the economic indicators described here are in phase or correlated positively with each other with the exception of percentage change in final consumption by households, which tends to lead the other indicators by one period.

4. Closing remarks about correlation between samples

The above analysis has been performed on a national level, that is, the variation of total return of all commercial property (in the sample comprising all 2232 properties of the IPD database) against economic and capital market variables were studied. It is expected that due to the large sample size of the combined national level property

performance information that a relatively accurate and reliable measure of correlation between property returns and the explanatory variables were obtained. The analysis performed with the larger sample would serve as a guide to the screening of the relevant explanatory variables on a nodal scale (smaller sample size) since similar relationships between the nodal values of total return and the explanatory variables are to be expected.

	Total Return: All property	Price-earnings ratio of all classes of shares	National inflation rate	% Change in disp. Income per capita	% Change in Final consumption expenditure by households	% change in Retail sales	% change in Electric current generated
Total Return: All property	1.0	0.3	-0.5	0.7	0.5	0.7	0.6
Price-earnings ratio of all classes of shares	0.3	1.0	0.3	0.3	0.5	0.5	0.3
National inflation rate	-0.5	0.3	1.0	-0.3	-0.2	0.0	0.1
% Change in disp. Income per capita	0.7	0.3	-0.3	1.0	0.9	0.8	0.7
% Change in Final consumption expenditure by households	0.7	0.5	-0.2	0.9	1.0	0.8	0.5
% Change in Retail sales	0.7	0.5	0.0	0.8	0.8	1.0	0.7
% Change in Electric current generated	0.6	0.3	0.1	0.7	0.5	0.7	1.0

Table 3.5: Matrix of Correlation coefficients for economic activity measures and total return (source:own)

It is therefore anticipated that the following conclusions (national level analysis) can be extended to the four individual property nodes as well (refer to Table 3.5):

- i. The correlation between economic activity variables (that is, % change in disposable income per household, % change in final consumption expenditure by households, % change in retail sales and % change in electric current generated by Eskom) and total property returns are relatively high. The correlation coefficients fall between 0.5 and 0.7. Here the correlation between % change in final consumption by households and total property returns had the lowest correlation at a value of $r = 0.5$.
- ii. The degree of correlation between economic activity variables are high and falls in the range 0.5 to 0.9. The relative high degree of correlation or co-movement confirms the statement that these parameters can be used as alternative proxies for economic activity. Due to the fact that these economic variables are highly correlated and all of the variables are describing changes in economic activity, it would thus not be correct to use more than one economic activity variable to explain returns on commercial property. The choice of economic variable will be guided by the regression coefficient between these individual economic parameters and property returns in a specific node and for a specific property type.
- iii. A low correlation (that is, on average a movement in opposite directions over time) exists between national inflation and total return ($r = -0.5$).
- iv. The degree of correlation between economic activity variables and national inflation is low or negative and ranges between -0.3 and 0.1. Thus, it is not anticipated that a significant duplication or double-counting of the explanatory power of macro-economic factors will occur if inflation is included in addition to these economic activity variables. Further, a low correlation between inflation and the economic activity variables is consistent with an out-of-phase movement (lead or lag) between inflation and economic activity variables. The inclusion of inflation will capture the out-of-phase effect of the historic economic conditions (as manifested in inflation) on current property returns in addition to the in-phase influence of economic activity variables at a specific point on the economic cycle.
- v. An intermediate degree of co-movement ($r = 0.3$) was observed between the P/E ratio and total property returns as well as between the P/E ratio and other indicators of economic activity.

3.2.2. Step 2: Initial screening of possible set of explanatory variables

In this step, the simple regression coefficients are calculated between the total return for a specific property type in a specific node against each possible determinant that were selected based on the findings of the literature review. Initial screening of relevant parameters within a category can now take place based on the identification of the explanatory variables with the highest regression coefficient (R^2 values) in a category. In addition, an explanatory variable will only be selected if the $R^2 \geq 0.05$ (that is if more than 5% of the variation in return of a specific property type in a specific node can be explained in terms of the explanatory variable under investigation). Furthermore the degree of correlation between variables that was calculated in Step 1 will be used to eliminate double-counting of the influence of some of the explanatory variables that are highly correlated. The correlation coefficients were calculated with MS Excel and results are to be found in Appendix 1.

Table 3.6 below now presents for the first time here, an equation for total return per property type and per node as a function of the parameters that were identified in the literature review and then passed through the screening process in Step 1 and Step 2.

What remains now is to calculate the contribution by each term or the strength or weight of each term in the linear multiple explanatory variable equations and perform statistical significance tests such as t-test and F-tests on these variables.

Please note that the individual coefficients are for simplicity sake all named B_i . However, the B_i 's will be different for each equation in Table 3.6, that is the strength or contribution of a specific parameter will be different from one equation (one property type and location or node) to another.

TABLE 3.6. Proposed equation of returns per property type and node in terms of explanatory variables

Cape Town	
Retail equation	$TRRET = B_1 \times BNDS3_5 + B_2 \times PE_JSE + B_3 \times NINFL + B_4 \times DISPINC + B_5 \times CAP + B_6 \times RM2$
Offices equation	$TROFF = B_1 \times BNDSGT10 + B_2 \times PE_JSE + B_3 \times CONSEXP + B_4 \times CAP + B_5 \times VAC + B_6 \times RM2 + B_7 \times GRM2$
Industrial equation	$TRIND = B_1 \times BNDS3_5 + B_2 \times PE_JSE + B_3 \times NINFL + B_4 \times ACDC + B_5 \times CAP + B_6 \times VAC$
Pretoria	
Retail equation	$TRRET = B_1 \times BNDS3_5 + B_2 \times NINFL + B_3 \times DISPINC + B_4 \times DRM2 + B_5 \times GRM2$
Offices equation	$TROFF = B_1 \times BNDSST + B_2 \times NINFL + B_3 \times DISPINC + B_4 \times DRM2 + B_5 \times GRM2$
Industrial equation	$TRIND = B_1 \times PE_JSE + B_2 \times NINFL + B_3 \times ACDC + B_4 \times INY + B_5 \times VAC + B_6 \times RM2$
Durban	
Retail equation	$TRRET = B_1 \times PE_JSE + B_2 \times NINFL + B_3 \times RETSALES + B_4 \times CAP + B_5 \times VAC + B_6 \times GRM2$
Offices equation	$TROFF = B_1 \times BNDS3_5 + B_2 \times PE_JSE + B_3 \times NINFL + B_4 \times DISPINC + B_5 \times INY + B_6 \times VAC + B_7 \times GRM2$
Industrial equation	$TRIND = B_1 \times BNDS3_5 + B_2 \times PE_JSE + B_3 \times NINFL + B_4 \times DISPINC + B_5 \times VAC + B_6 \times GRM2$
Bloemfontein	
Retail equation	$TRRET = B_1 \times PE_JSE + B_2 \times RETSALES + B_3 \times CAP + B_4 \times VAC + B_5 \times GRM2$
Offices equation	$TROFF = B_1 \times BNDSGT10 + B_2 \times NINFL + B_3 \times CONSEXP + B_4 \times CAP$
Industrial equation	n/a

3.2.3. Step 3: Model building through multiple regression and statistical significance testing

The purpose of this step is to quantify the strength or weight of each explanatory variable (as expressed in terms of the B_i 's) that passed the screening process in Step 1 and 2. The magnitudes of the respective B_i 's reflect the degree to which investment exposure to the specific explanatory variables (that resemble systematic risk factors) is rewarded in the form of increased returns.

In Step 3, multiple regression and statistical significance (ANOVA) testing can be used as statistical methods to assist with quantification of the relevant explanatory variables. Specifically, the 'Regression module' of the MS Excel program was used to calculate the B_i 's and statistical significance of the individual B_i 's that were resolved. The results are presented in Appendix 3.

Table 3.7 below shows the empirically established equation which describes returns for each property type and node within the scope of this study. Chapter Four is devoted to discuss the content of Table 3.7 in detail.

TABLE 3.7. Equation of returns per property type and node in terms of explanatory variables

Cape Town	
Retail equation	TRRET = -45.8 + 2.11xBNDS3_5 + 3.82xPE_JSE + 1.86xNINFL - 2.68xDISPINC - 6.87xCAP + 0.89xRM2 (multiple R ² = 0.851)
Offices equation	TROFF = 173.20 - 1.191xBNDSGT10 - 4.63xPE_JSE + 0.34xCONSEXP - 6.19xCAP + 0.44xVAC -0.81xRM2 + 1.11xGRM2 (multiple R ² = 0.998)
Industrial equation	TRIND = 111.78 + 0.56xBNDS3_5 - 2.2xPE_JSE - 1.72xNINFL -1.84xACDC - 5.1xCAP -0.66xVAC (multiple R ² = 0.992)
Pretoria	
Retail equation	TRRET = 29.3 - 0.31xBNDS3_5 - 1.30xNINFL + 1.63xDISPINC - 0.06xDRM2 - 0.11xGRM2 (multiple R ² = 0.703)
Offices equation	TROFF = 21.34 - 1.1xBNDSST + 0.76xNINFL + 3.03xDISPINC - 0.42xDRM2 + 0.74xGRM2 (multiple R ² = 0.962)
Industrial equation	TRIND = -10.7 + 0.05xPE_JSE - 0.11xNINFL + 1.00xACDC + 2.21xINY - 0.11xVAC + 0.285 xRM2 (multiple R ² = 0.813)
Durban	
Retail equation	TRRET = 109.70 - 4.85xPE_JSE - 1.78xNINFL + 1.27xRETSALES + 0.47xCAP - 6.24xVAC -0.35 xGRM2 (multiple R ² = 0.892)
Offices equation	TROFF = -3.52.96 + 1.64xBNDS3_5 + 10.81xPE_JSE + 8.35xNINFL + 3.82xDISPINC + 17.79xINY - 1.493xVAC - 2.59xGRM2 (multiple R ² = 0.982)
Industrial equation	TRIND = 12.54 - 1.63xBNDS3_5 + 1.29xPE_JSE + 0.83xNINFL + 1.27xDISPINC - 1.05xVAC + 0.24xGRM2 (multiple R ² = 0.911)
Bloemfontein	
Retail equation	TRRET = 20.30 - 0.16xPE_JSE + 1.028xRETSALES - 0.39xCAP - 0.75xVAC - 0.07xGRM2 (multiple R ² = 0.908)
Offices equation	TROFF = 110.29 - 3.34xBNDSGT10 + 0.87xNINFL - 0.19xCONSEXP - 4.69xCAP (multiple R ² = 0.683)
Industrial equation	n/a

3.3. Summary

In this chapter, data samples from the IPD database, SARB and StatsSA, pertaining to the explanatory variables that were identified in the previous chapter, were statistically and mathematically studied. By using the coefficient of regression for data samples from the capital market and property market fundamental parameter categories, those variables with the strongest explanatory power could be identified. It is also important to note the literature review pointed out that a degree of duplication or double counting of the explanatory power of specifically economic variables could occur since these variables all proxy for expansion or contraction in economic activity. Using criteria and methods based on a combination of the regression (coefficient) with returns and correlation coefficients between variables, the possible economic variables that describes returns optimally, were selected. The chapter culminated in an equation that explains returns per property type and node for four nodes and three property types. Since these equations (Table 3.7) are one of the primary results of the research object, the following chapter will discuss the equations in detail.

CHAPTER FOUR: DISCUSSION OF RESULTS

4.1. Introduction

In Chapter Three, a great deal of attention was devoted to discussing the data sample selection and quantification process, data processing as well as the methodology for providing a multi-factor model of returns. In that discussion, some aspects pertaining to the secondary objectives of this dissertation have already been addressed. However, the main result of the empirical investigation in Chapter Three and also one of the main secondary objectives of this study, namely the formulization of a model for return per property type and node, has not yet been discussed. This chapter will analyse the mathematical equation or model of return per property type and node, which was derived in the previous chapter and certain improvements will be implemented along the discussion. The discussion here will be organised around a (i) geographic or nodal and (ii) a property type focus on the equations that were derived and the following aspects will be analysed in this chapter:

1. The R^2 values that statistically describe the overall fit or more specifically, the degree to which the variation in return for a specific property and node can be accounted for by the explanatory variables ($X_1 \dots X_8$) used in the multiple regression.
2. Statistical significance and goodness of fit of results in terms of an ANOVA analysis with specific reference to the F-test.
3. Identification of patterns in the explanatory variables that describe returns in the regressions or fits that passed the F-test. This will be accomplished by an analysis of the number of times a specific explanatory variable was used to express returns per node and property type.
4. Discussion pertaining to the integration of the theory and empirical investigation. This discussion will pertain to the regressions that passed the final F-tests and t-tests.

4.2. Multiple regression coefficients

Figure 4.1. below shows the multiple regression coefficients, R^2 for each property type and node (please refer to Appendix 1 for data). It can be seen that in each of Cape Town (Offices and Industrials), Pretoria (Offices), Durban (Offices and Industrials) and Bloemfontein (Retail), more than 90% of the variation in returns could have been attributed to variation in the set of explanatory variables that were used in the multifactor regression in each of these nodes. The second lowest and overall lowest attribution by the set of explanatory variables to variation in return was noted for Retail sites in Pretoria and Offices in Bloemfontein. Therefore, the combined explanatory power of the respective sets of variables used in each regression in these nodes is relatively poor compared to the other nodes and property types.

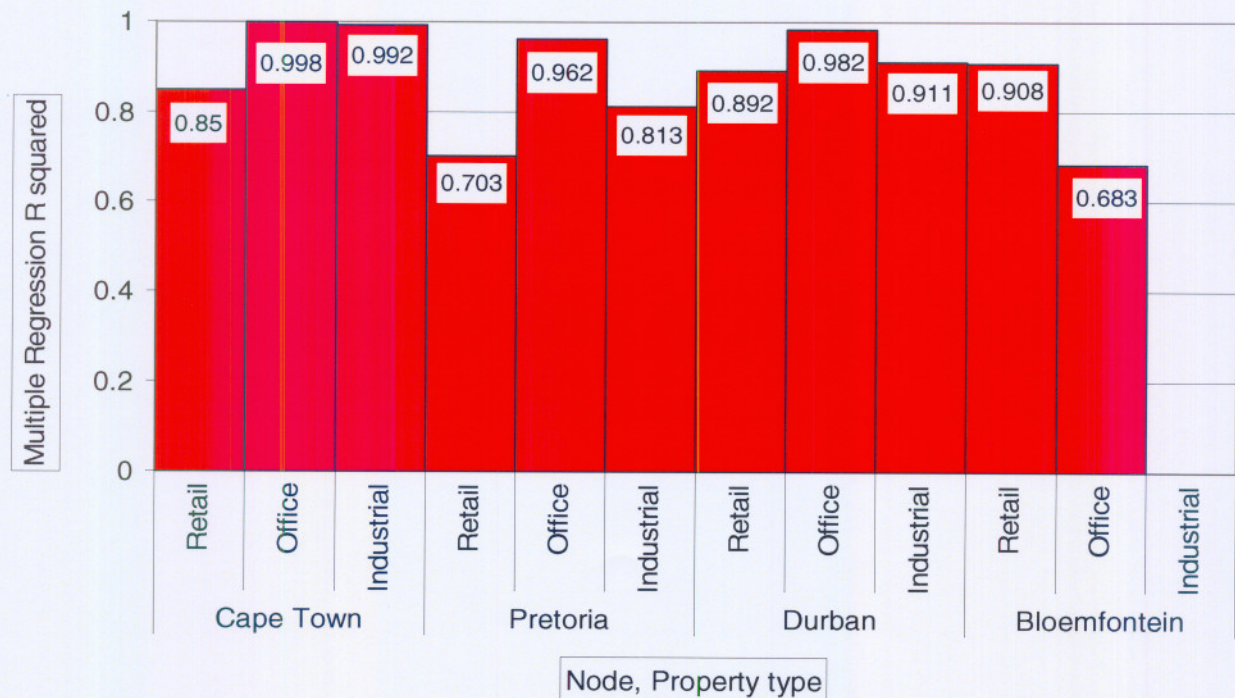


Figure 4.1: Multiple regression coefficients per property type and node (source: own)

4.3. Results of the F-tests and t-tests for each property type and node

The question that needs to be answered by any researcher that performed a multiple regression on a set of variables is how good the overall fit on a set of explanatory variables is. The R^2 alone (refer to the previous section) cannot provide an answer to

this question but the F-test, which is a hypothesis test on R^2 can shed light on this issue. The F-test value (indicated by 'F' in the tabulated results for each node in Appendix 2) can be tested against a critical F value at a specified significance level. If the critical value is exceeded one is forced to reject the null hypotheses (see Appendix 2). On the contrary, if the critical F is not exceeded then one is forced to say that the null hypothesis is not rejected. Figure 4.2. below shows the property nodes and types for which the null hypothesis were rejected because the critical F-value at the significance level of 90% or $\alpha = 0.1$, were not attained.

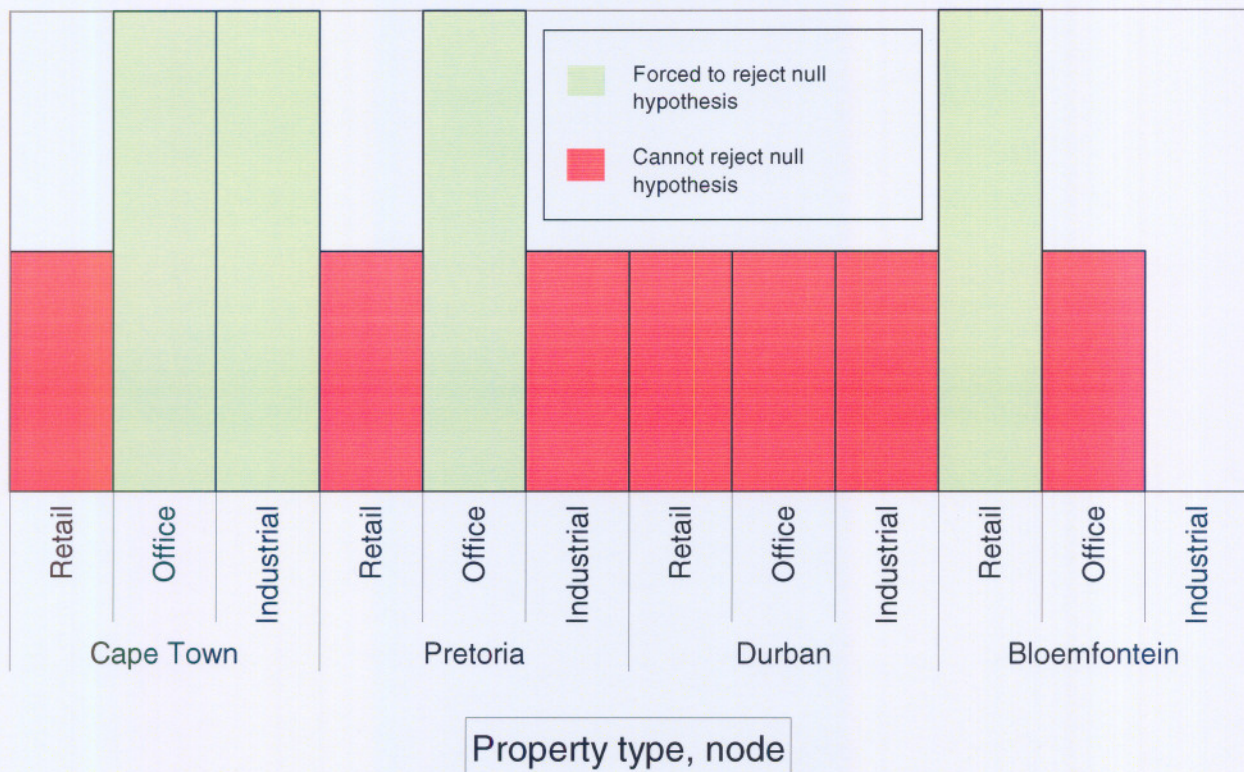


Figure 4.2: Results of F-test for each property node and type in order to assess the overall goodness of fit of the multi-factor regression line at $\alpha = 0.10$ (source: own)

The above Figure 4.2 shows that the overall goodness of fit is unacceptable for the estimated regression equation or model for Cape Town (Retail), Pretoria (Retail and Industrial), Durban (Retail, Offices, Industrials) and Bloemfontein (Retail). Statistically, the estimated equations that were derived for these nodes and property types, are not reliable and it is therefore not appropriate to apply these equations in practice.

On the contrary, the respective models for Cape Town (Offices and Industrials), Pretoria (Offices) and Bloemfontein (Retail) have an overall goodness of fit at the 90% confidence level. However, this does not necessarily imply that each variable is making a significant contribution and an additional test known as the t-test needs to be performed using a package such as MS Excel. By looking at the 'P-value' for each 't Stat' in Appendix 2 and 3 (that is the result of a t-test) one can establish which of the explanatory variables in each case, is statistically significant at for example the alpha = 0.1 or 90% significance level. More specifically, only those variables with a 'P-value' less than 0.1 are considered statistically significant.

Now, from studying the results from the t-test, one can conclude the following about the set of explanatory variables of returns observed for each property type and node that has passed the F-test in the first round of multiple regression as described in the above:

1. In Cape Town, returns on Offices are described by the following statistically significant parameters (at 90% confidence level): an intercept value, PE_JSE, CAP, RM2 and GRM2. However, it is important to realise here that after dropping the other explanatory variables with which the multiple regression process was initiated, one can not assume that the new model (expressed in terms of less explanatory variables) of returns for Offices in Cape Town is statistically sound. In fact, for Office returns, the multiple regression process was put through two more iterations (multiple regression process as well as F-test and t-test on each individual variable) until it was found that at the 90% confidence level, the CAP rate is the only statistically significant explanatory variable of office returns in Cape Town. The R^2 was 0.69, that is, 69% of the variation in returns on Offices can be explained in terms of variation in CAP rate. The equation of office returns in Cape Town is therefore:

$$TROFF_{CapeTown} = -2.84xCAP + 42.6$$

2. Returns on Cape Town Industrial sites are described by statistically significant parameters (at the 90% confidence level) which include the following: an intercept value, PE_JSE, NINFL, ACDC and CAP. Once again, the regression and significance tests can not be terminated here and a second round of F- and t-tests were applied to a multiple regression on these variables. It was

confirmed (at the 90% confidence level) that returns on Industrial sites, are explained by the following combination of statistically significant parameters, namely: an intercept value, PE_JSE, NINFL, ACDC and CAP. According to the multiple regression coefficient (R^2), 98.2% of the variation in returns on Industrial sites can be attributed to variation in these variables. The equation of industrial site returns in Cape Town is therefore:

$$TRIND_{CapeTown} = 82.5 - 1.02xPE_JSE - 1.58xNINFL + 2.04xACDC - 4.13xCAP$$

3. In Pretoria, returns on Offices are described by the following statistical significant variables (at 90% confidence level), namely: DISPINC and GRM2. As before, statistical significance and overall goodness of fit tests (F-test and t-test on each individual variable) were applied to a multiple regression on Returns, DISPINC and GRM2 in a follow-up iteration using the MS Excel package 'regression' function. As before the purpose of the additional iterations was to confirm and to quantify significance of the reduced set explanatory variables (that is, DISPINC and GRM2). At the 90% confidence level an overall goodness of fit was attained (that is, the regression passed the F-test). It was found for that 89.0% (R^2) of the variation in return on offices in Pretoria are attributable to variation in DISPINC and GRM2 as follows:

$$TROFF_{Pretoria} = 3.53xDISPINC + 0.79xGRM2$$

4. Finally, in Bloemfontein, returns on Retail Properties are described by only one statistically significant parameter (at 90% confidence level) namely RETSALES. As described above, a second round of F- and t-tests were performed to establish the statistical significance of RETSALES as an explanatory variable and the overall goodness of fit. At the 90% confidence level, it was found that 72.6% of the variation in returns on retail sites in Bloemfontein could be attributed to variation in retail sales (as an indicator of national economic activity). The equation is as follows:

$$TRRET_{Bloemfontein} = 6.45 + 1.40xRETSALES$$

4.4. Analysis of patterns amongst explanatory variables

Figure 4.3 below shows the number of times an explanatory variable was used in the four multiple regression fits that passed the first round of F- and t-tests. It is clear that alternative returns as expressed by returns on the stocks on the JSE (PE_JSE) as well as the property market fundamental parameters are common factors in explaining returns in the multiple regressions that passed the first round of F- and t-tests. (The specific property fundamental parameters include CAP, VAC, RM2, GRM2 and DRM2.) In addition, it must be noted that three respective indicators of economic activity namely, the consumption expenditure by households (CONSEXP), disposable income (DISPINC) and retail sales (RETSALES) are also common economic activity factors that contribute to explaining returns. Another economic variable namely the nodal inflation rate, featured once as an explanatory variable in the regressions that were characterised by an overall goodness of fit. Finally, in three cases the concept of a risk-free rate as an explanatory factor of return became apparent. In two of these cases the long bond rate, namely greater than 10 years and 3 to 5 years maturity period bonds have surfaced as explanatory variables of returns. What is surprising is that 91- day treasury bonds appear to be the third type of proxy for the risk free rate. According to the theory, investors would not usually prefer to use 91-day bonds as the risk-free rate due to the longer investment horizon associated with a property investment.

Finally, in the case of offices and industrial properties in Cape Town, economic activity measures, the risk-free rate (long or short maturity bonds), alternative returns on the JSE and property fundamental parameters (CAP rate and vacancy) are commonly found explanatory factors of returns.

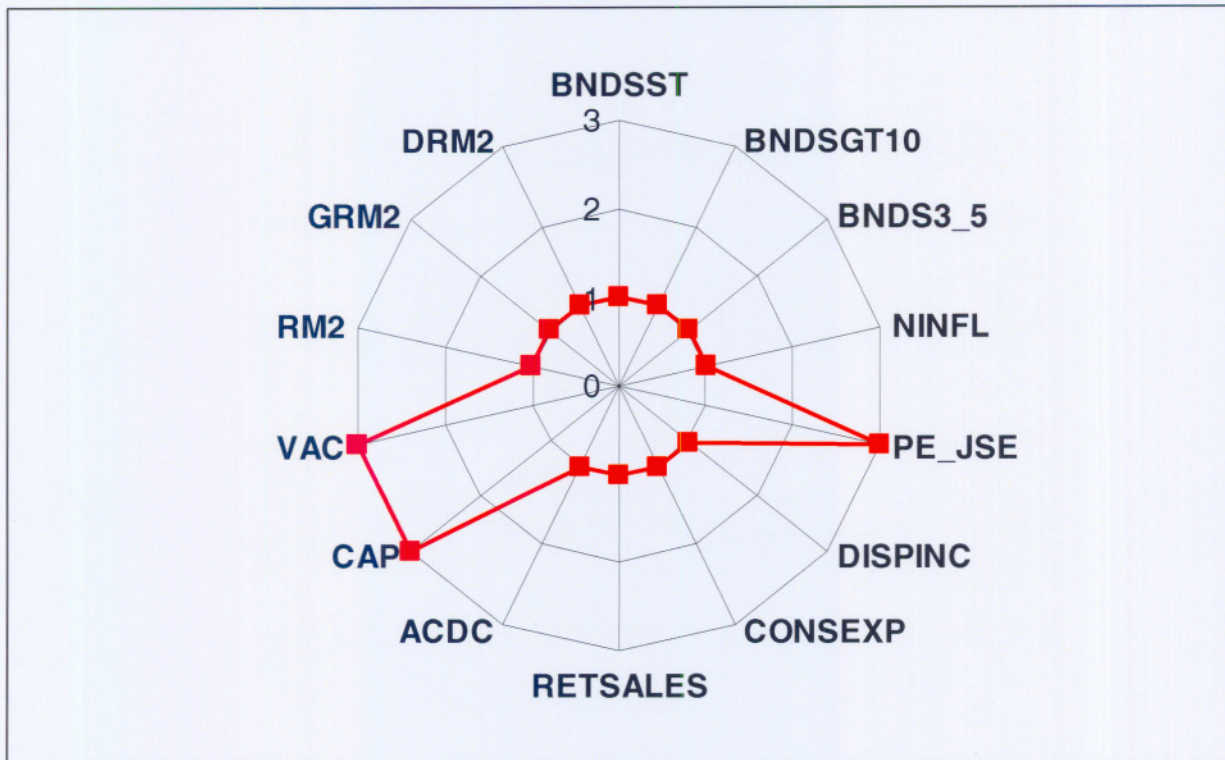


Figure 4.3: Number of times an explanatory variable, which was part of a multiple regression that passed the F-test, were encountered (source: own).

4.5. Summary and conclusions

In the previous chapter, a set of property performance data and economic (capital market and economic activity indicators) were subjected to an analysis in order to derive equations for required return rate on three commercial property types from four geographic nodes in SA. The specific set of variables was identified on theoretical grounds and the sample selection was guided by the availability of data.

This chapter (four) refined the analysis further and discussed the empirically derived equations (obtained in Chapter Three) for property returns in four nodes and three types of property. The primary conclusion here is that a large amount of the observed variation of property returns (refer to Figure 4.1) can be attributed to the variation in the set of explanatory variables that were identified from the theory.

However, a first round of statistical significance tests (F- and t-tests) showed that not all parameters are statistically significant. A second (and in some cases a third) round of

multiple regressions and statistical significance tests had to be performed until statistically insignificant parameters were eliminated. The outcome of this exercise was four equations of property returns in Cape Town, Pretoria and Bloemfontein.

From the final equations of returns for Cape Town Office buildings and industrial sites, Pretoria offices and Bloemfontein retail sites the following can be concluded:

1. In three of the four models of return described, it is observed that property market fundamental parameter (CAP or GRM2) is a significant statistical explanatory variable of return. However, for both parameters, the signs of the coefficients are the opposite of what was expected.
2. CAP rate is an important explanatory variable for returns on commercial property in Cape Town and it appears in two of the final four statistically significant equations of returns. The negative contribution by CAP was anticipated from the observations by R & A (see Figures 2.4 to 2.7).
3. The positive sign of GRM2 is not anticipated from the theory but can possibly be attributed to a lag in response of property values (prices of property) to a growth in rental income. In other words, property prices take time to adjust to higher net income from rent, which has been the result of a growth in rent per square meters. In the equation of return, which is the ratio of change in income divided by price paid for the property, the numerator increases at a faster rate than the denominator (price paid). It therefore appears that the return rate increases concurrently with the return as a growth in rent per square meter occurs. (The whole phenomenon observed here could also be the result of the aggregation of property performance data over a relative small sample that make the market appear as not being efficient in rapidly adjusting the price of the property due to change in fundamentals such as growth rate of rental income.)
4. Alternative returns (PE_JSE) on investment opportunities (as proxied by the PE ratio of the JSE) only seem to be an important explanatory variable in returns on industrial property in Cape Town. The sign of the coefficient was as anticipated from the theory.
5. Economic variables and in particular indicators of economic activity namely RETSALES, ACDC and DISPINC are statistically significant determinants of

returns in three of the four above equations and the signs of the coefficients are as expected from the theory.

6. The theory anticipates investors to choose the bond rate that would proxy for a risk-free rate of return on the investment. However, the bond rate did not prove to be a statistically significant determinant of return unless it is argued that the offset of each equation contains an element of the risk-free rate plus an error (unexplained) term. This seems unlikely since the yield on bonds were explicitly included in the regression equation as a possible explanatory variable.
7. Finally, the rent per square meter, which is regarded as a significantly strong fundamental property parameter, did not pass the rigorous tests that were applied here. According to the literature review (R & A s model), it is expected that separate relations of returns exist for specific ranges of property sizes. By aggregating returns such as in the IPD database, the relation might be diminishing thus leading to the explanatory power of rent per square meter being artificially low.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1. General conclusions

This dissertation studied the determinants of the required return rate on direct commercial property in the South African context. The scope of the work was organised around the achievement of two objectives:

1. The primary objective required the review of theory as well as empirical findings on the topic, in order to identify the determinants of required return on direct commercial property investments. The review focussed on two MPT frameworks for asset returns, another five frameworks of required return on commercial real estate as well as the macro-economic determinants of property returns. Chapter Two describes the outcomes of the work related to the primary objective and concluded with a list of possible explanatory variables that are relevant to the SA property returns. A rationale for the selection of these determinants of property returns, were also provided. The conclusion from the work done in chapter two, is that the list of explanatory variables of return rate in property investment is not exhaustive at all. It is also not claimed here that the list of explanatory variables encountered, capture all relevant economic or other non-diversifiable risks. Rather, these variables jointly proxy for a set of underlying variables or effects that, to a (sufficiently) large extent, determine real estate asset returns. The fact that these factors are jointly used to explain returns, emphasise the findings in the literature review that there does not exist a single variable that explain returns on commercial real estate. Further, the explanatory power of these variables is different between geographic regions and property types.

The list of possible explanatory variables of returns that were identified from the theory includes the following:

- i. k_{RF} or the risk-free rate of return,
- ii. Market beta,

- iii. Non-risk factors such as transaction costs, cost of advertising a property, cost related to the indivisibility of real estate and lock-up of large amount of capital in just one asset,
- iv. Cap rate,
- v. Cost of capital deployed for financing the investment,
- vi. Inflation,
- vii. Fundamental property market specific factors such as tenant mix, vacancy rate, property type, geographic location, growth in rent per square meters,
- viii. Opportunity cost of forgoing alternative investments on the stock exchange,
- ix. Gross market rent per square meters,
- x. GDP growth,
- xi. Industrial output,
- xii. Unanticipated inflation; and,
- xiii. Short term interest rates.

In order to determine a realistic model of required return that an investment professional can readily apply in practise, only parameters of which the data are easily available were short-listed from the above list of theoretical variables. The data samples that were used for the empirically investigation of these parameters are available from organisations such as the IPD, the SARB and StatsSA. The explanatory variable selected for the empirical study can be organised in three categories, namely:

- i. Capital market variables, that relates to the investors risk-free rate (that is, short and long SA government bonds) and variables related to alternative investment returns on the JSE (that is, return on all shares on the JSE, as reflected by the JSE's P/E ratio on all shares).
- ii. Economic variables, which include inflation rate and indicators of economic activity such as retail sales, electricity supplied by Eskom, disposable income per household and household expenditure.

- iii. Property market fundamental parameters such as vacancy, rent per square meter and growth in rent per square meter.

2. The secondary objective was achieved by application of the above theory to financial performance data of commercial property and economic data in order to determine empirically the explanatory power of each variable for local conditions. The scope of the empirical investigation (secondary objectives) included a study of returns in four property nodes (Cape Town, Pretoria, Bloemfontein and Durban) and three property types (Retail, Offices and Industrial sites). A linear equation or model was derived from application of statistical methods and the multiple-regression technique to property performance and economic data. *A very important assumption was made in the study: It was assumed that the reported (aggregate) data of observed property returns by the industry approximate the investor's required rate of return. Since property data is aggregated over a number of properties in each node, some of the inefficiency in the property market that results in individual properties trading for longer periods at prices above or below the level that matches the specific level of risk, is diluted or mathematically (artificially) reduced. The return per annum per property type and node thus on average approximates the investor's required return. In other words, property returns, in the aggregated data set approaches the return that property investors require at the specific level of risk.*

The empirical methodology was based on the following rationale: When calculating the required return, investors require compensation in the form of additional premiums (returns) for bearing the systematic risk associated with exposure to each of the list of factors identified in Tables 2.2 and 2.3, respectively. This rationale lead the researcher to investigate and derive a multi-factor model of returns which is in essence a linear equation comprising several terms that jointly reflect the compensation that investors require for bearing non-diversifiable risk.

The process that was described here was completed and an equation for each property node and type was derived and presented at the end of Chapter Three. However, a

rigorous process aimed at improving the overall fit of each equation and eliminating the statistically insignificant variables, was continued in Chapter Four. After completion of the process, only four of the original eleven derived equations remained, that was statistically a sound reflection of returns. The equations describe returns for Cape Town (Offices and Industrials), Pretoria (Offices) and Bloemfontein (Retail sites). The explanatory variables of these four equations included a combination of:

- i. two property market fundamental parameters (GRM2 and CAP),
- ii. alternative opportunities on the JSE (PE_JSE) and
- iii. economic factors (NINFL and RETSALES, ACDC and DISPINC).

The parameters behaved as expected from the theory with respect to the sign (+ or –) of each of the terms that contain the above parameters with the exception of growth in rent per square meters (GRM2). Possible explanations were provided why the parameter behaved differently than expected.

The following should be noted about the seven rejected equations: The eight rejected equations probably have some form of explanatory power of returns based on the addition of several premiums that contribute to overall explanation of the returns. However, the author of this dissertation would from a scientific and management point of view not be as comfortable to use these equations for investment decisions, as the author is comfortable to use the final four equations of returns.

In conclusion, it is the opinion of the author that the derivation of the final four equations is sound from a scientific (economic and mathematical) point of view. In addition, it should be noted here that the explanatory power of these four equations compares favourably to the only other model related to SA property returns that was well described in the literature, namely R & A's cap rate equations for retail, offices and industrial properties. The variation in returns that are attributed by the variation in explanatory variables for R & A's model are not particularly high and the regression coefficient are as follows for the respective property types: Retail ($R^2 = 0.7693$); Offices ($R^2 = 0.7268$); Industrials ($0.6834 \leq R^2 \leq 0.8296$). Since CAP rate is a determinant of return or at least closely related to total return (if the latter is used as the hurdle rate), the single factor (in terms of market rent per square meter) model used by R & A, is anticipated to have an even weaker explanatory power of total return or hurdle rate. For

the purpose of comparison, the final four equations derived in this study have the following multiple regression coefficients: Cape Town (Retail, $R^2 = 69\%$; Industrials, $R^2 = 98.2\%$), Pretoria (Offices, $R^2 = 89.0\%$) and Bloemfontein (Retail, $R^2 = 72.6\%$) at the 90% confidence level. The variation in returns that are attributed by the variation in explanatory variables in these four equations is surely an improvement over the R & A model. The improvement is likely to be due to the higher explanatory power of a multitude of appropriately selected variables.

5.2. Recommendations for further research

The following are general recommendations for further research and are mainly aimed at improving the explanatory power of the derived equations through better validation of underlying trends amongst a larger sample of explanatory parameters. More specifically the following is recommended:

1. The empirical data was sponsored by the Investment Property Databank and was therefore exclusively used in this study. However, the methodology that was developed here should be applied to other property databases as well, to test the applicability of the methodology on a broader scale.
2. The use of a time series spanning more samples (more than the past 10 year's of data) could potentially improve the explanatory power of individual variables and lead to the inclusion of variables that were rejected here on statistical grounds. This statement should be investigated in another study as well.
3. The study of the correlation amongst property fundamental parameters, as well as the correlation of property fundamental parameters with economic parameters could potentially improve understanding of the observed trends. Here specific attention should be given to explain the lead-lag of the respective parameters with each other. In particular, the GRM2 should be investigated as discussed earlier.
4. Economic factors that express economic activity for the major metropolitan or geographic nodes as opposed to the national basis should be applied in each nodal equation. Once again, the national economic parameters were used due to ease of availability. StatsSA could be approached for more data of nodal indicators of economic activity.

5. It is anticipated that the portion of the variation in returns that are not explained by the variables found in each of the final four equations derived, might be attributed to property specific factors such demographic (for example an aging population), geographic factors (for example the layout of access ways to property etc.) and other non-risk factors described in the literature review. However, these variables are not readily recorded in the industry but might provide the key to improving the explanatory power of the equations significantly.
6. The use of aggregated data (that is, compounded quarterly in the case of IPD) could potentially dilute the effect of explanatory variables on each other as well as on returns in general. In order to refine the equations that were derived in the study, the raw (not aggregated) data should be acquired and subjected to the empirical methodology described here.

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2A. RESULTS OF MULTIPLE REGRESSION ANALYSIS FOR CAPE TOWN

SUMMARY OUTPUT		OFFICER		RETAIL	
INDUSTRIALS		INDUSTRIALS		INDUSTRIALS	
Regression Statistics		Regression Statistics		Regression Statistics	
Multiple R	0.995	Multiple R	0.969	Multiple R	0.923
R Square	0.992	R Square	0.998	R Square	0.851
Adjusted R Square	0.977	Adjusted R Square	0.993	Adjusted R Square	0.554
Standard Error	1.161	Standard Error	0.931	Standard Error	5.157
Observations	10,000	Observations	9,000	Observations	10,000

ANOVA		ANOVA		ANOVA	
	df	SS	MS	F	Significance F
Regression	6,000	519,780	86,631	84,270	0.003
Residual	3,000	4,044	1,348		
Total	9,000	523,823			

ANOVA		ANOVA		ANOVA	
	df	SS	MS	F	Significance F
Regression	7,000	166,835	23,834	67,773	0.093
Residual	1,000	0,368	0,368		
Total	8,000	167,203			

ANOVA		ANOVA		ANOVA	
	df	SS	MS	F	Significance F
Regression	8,000	111,969	13,996	111,969	0.008
Residual	3,000	76,784	25,595		
Total	9,000	188,753			

Explanatory variable	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-45.776	49.537	-0.924	0.424	-203.428	111.969
BND93_5	2.110	2.528	0.835	0.465	-5.936	10.157
PE_JSE	3.822	2.305	1.658	0.106	-3.513	11.157
NINFL	1.658	2.042	0.810	0.430	-4.639	8.355
DISPINC	-2.684	3.519	-0.763	0.501	-13.984	8.515
CAP	-8.865	5.126	-1.339	0.273	-23.179	6.448
RM2	0.865	0.465	1.824	0.165	-0.659	2.429

Explanatory variable	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	173.204	14.230	12.172	0.052	-7.800	354.008
BND93_5	-1.188	0.251	-4.718	0.133	-4.370	2.008
PE_JSE	-4.630	0.590	-7.846	0.081	-12.127	2.868
CDNSEKP	0.340	0.411	0.827	0.580	-4.895	5.505
CAP	-8.194	0.744	-10.999	0.076	-15.663	3.265
VAC	0.437	0.117	3.726	0.167	-1.054	1.928
RM2	-0.806	0.109	-7.455	0.095	-2.180	0.568
GRM2	1.110	0.116	9.540	0.066	-0.368	2.587

Explanatory variable	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	111.777	20.524	5.446	0.012	46.480	177.094
BND93_5	0.258	0.265	0.971	0.403	-0.587	1.103
PE_JSE	-2.304	0.786	-3.008	0.057	-4.741	0.133
NINFL	-1.719	0.224	-7.692	0.005	-2.431	-1.008
ACDC	1.839	0.244	7.549	0.005	1.064	2.614
CAP	-5.074	0.902	-5.626	0.011	-7.844	-2.204
VAC	-0.657	0.345	-1.907	0.153	-1.755	0.440

2B. RESULTS OF MULTIPLE REGRESSION ANALYSIS FOR PRETORIA

SUMMARY OUTPUT										SUMMARY OUTPUT										SUMMARY OUTPUT									
RETAIL										OFFICES										INDUSTRIALS									
Regression Statistics										Regression Statistics										Regression Statistics									
Multiple R	0.838									Multiple R	0.991									Multiple R	0.901								
R Square	0.703									R Square	0.982									R Square	0.813								
Adjusted R Square	0.331									Adjusted R Square	0.914									Adjusted R Square	0.438								
Standard Error	4.883									Standard Error	2.517									Standard Error	3.892								
Observations	10.000									Observations	10.000									Observations	10.000								
ANOVA										ANOVA										ANOVA									
	df	SS	MS	F	Significance F						df	SS	MS	F	Significance F						df	SS	MS	F	Significance F				
Regression	5.000	275.485	45.087	1.892	0.278					Regression	5.000	634.641	126.928	20.033	0.006					Regression	6.000	196.940	32.825	2.187	0.281				
Residual	4.000	95.357	23.839					Residual	4.000	25.344	6.336					Residual	3.000	45.438	15.146										
Total	9.000	320.842					Total	9.000	659.985					Total	9.000	242.386													
Explanatory variable	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	Explanatory variable	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	Explanatory variable	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%			
Intercept	28.259	27.040	1.082	0.340	-45.816	104.334	-45.816	104.334	Intercept	21.335	19.373	1.101	0.333	-32.453	75.124	-32.453	75.124	Intercept	-10.707	40.434	-0.265	0.808	-139.386	117.972	-139.386	117.972			
BNDS_3_5	-0.308	1.598	-0.163	0.856	-4.744	4.127	-4.744	4.127	BNDS&T	-1.050	0.621	-1.691	0.166	-2.773	0.673	-2.773	0.673	PE_JSE	0.052	1.508	0.035	0.975	-4.746	4.850	-4.746	4.850			
NINFL	-1.296	0.878	-1.476	0.214	-3.734	1.141	-3.734	1.141	NINFL	0.757	0.597	1.267	0.274	-0.901	2.414	-0.901	2.414	NINFL	-0.108	0.174	-0.611	0.584	-0.660	0.447	-0.660	0.447			
DISPINC	1.630	1.298	1.256	0.277	-1.973	5.233	-1.973	5.233	DISPINC	3.030	0.810	3.742	0.020	0.782	5.279	0.782	5.279	ACDC	1.005	0.672	1.496	0.232	-1.133	3.142	-1.133	3.142			
DRM2	-0.056	0.160	-0.347	0.746	-0.500	0.389	-0.500	0.389	DRM2	-0.422	0.394	-1.071	0.344	-1.515	0.672	-1.515	0.672	INY	2.210	1.125	1.964	0.144	-1.371	5.790	-1.371	5.790			
GRM2	-0.110	0.123	-0.897	0.421	-0.450	0.230	-0.450	0.230	GRM2	0.741	0.333	2.229	0.090	-0.182	1.664	-0.182	1.664	VAC	-0.107	0.291	-0.367	0.738	-1.034	0.820	-1.034	0.820			
																			RM2	0.258	1.642	0.157	0.885	-4.967	5.482	-4.967	5.482		

2C. RESULTS OF MULTIPLE REGRESSION ANALYSIS FOR DURBAI

SUMMARY OUTPUT		OFFICES		RETAIL		
<p>Regression Statistics</p> <p>Multiple R 0.881</p> <p>R Square 0.882</p> <p>Adjusted R Square 0.859</p> <p>Standard Error 2.592</p> <p>Observations 9,000</p>		<p>Regression Statistics</p> <p>Multiple R 0.844</p> <p>R Square 0.862</p> <p>Adjusted R Square 0.867</p> <p>Standard Error 5.971</p> <p>Observations 9,000</p>		<p>Regression Statistics</p> <p>Multiple R 0.955</p> <p>R Square 0.911</p> <p>Adjusted R Square 0.845</p> <p>Standard Error 4.069</p> <p>Observations 9,000</p>		
ANOVA		ANOVA		ANOVA		
	df	SS	MS	F	Significance F	
Regression	7,000	374,059	53,437	7,956	0.267	
Residual	1,000	6,716	6,716			
Total	8,000	380,774				
Explanatory variable		Explanatory variable		Explanatory variable		
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-352.862	140.383	-2.514	0.241	-2106.684	1430.761
BND\$3	1.840	2.197	0.747	0.502	-26.270	29.559
PE JSE	10.813	3.481	3.107	0.198	-33.412	55.039
NINFL	8.352	2.485	3.348	0.185	-23.345	40.048
DISPINC	3.824	2.358	1.623	0.352	-26.115	33.763
INY	17.785	6.412	2.774	0.220	-63.692	99.262
VAC	-1.483	0.353	-4.231	0.148	-5.976	2.990
GRM2	-2.592	0.751	-3.451	0.180	-12.137	6.952

2D. RESULTS OF MULTIPLE REGRESSION ANALYSIS FOR BLOEMFONTEIN

SUMMARY OUTPUT										SUMMARY OUTPUT									
RETAIL										OFFICES									
<i>Regression Statistics</i>										<i>Regression Statistics</i>									
Multiple R	0.953									Multiple R	0.827								
R Square	0.908									R Square	0.683								
Adjusted R Square	0.754									Adjusted R Square	0.367								
Standard Error	3.796									Standard Error	6.559								
Observations	9.000									Observations	9.000								
<i>ANOVA</i>										<i>ANOVA</i>									
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>						<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>				
Regression	5.000	425.995	85.199	5.914	0.087					Regression	4.000	371.320	92.830	2.158	0.237				
Residual	3.000	43.219	14.406							Residual	4.000	172.063	43.016						
Total	8.000	469.214								Total	8.000	543.383							
<i>Explanatory variable</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>		<i>Explanatory variable</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>	
Intercept	20.305	38.761	0.524	0.637	-103.050	143.661	-103.050	143.661		Intercept	110.293	88.091	1.252	0.279	-134.286	354.872	-134.286	354.872	
PE_USE	-0.157	1.758	-0.089	0.935	-5.751	5.438	-5.751	5.438		BNDSGT10	-3.337	1.821	-1.833	0.141	-8.393	1.718	-8.393	1.718	
RETSALES	1.028	0.343	2.998	0.058	-0.063	2.119	-0.063	2.119		NINFL	0.871	2.848	0.306	0.775	-7.035	8.777	-7.035	8.777	
INY	-0.389	1.505	-0.258	0.813	-5.178	4.400	-5.178	4.400		CONSEXP	-0.187	0.912	-0.205	0.847	-2.718	2.344	-2.718	2.344	
VAC	-0.746	0.471	-1.583	0.212	-2.246	0.754	-2.246	0.754		CAP	-4.691	4.073	-1.152	0.314	-16.000	6.617	-16.000	6.617	
GRM2	-0.068	0.117	-0.577	0.604	-0.442	0.306	-0.442	0.306											

APPENDIX 3: RESULTS OF MULTIPLE REGRESSION AND STATISTICAL SIGNIFICANCE (SUBSEQUENT ITERATIONS)

A. Cape Town

SUMMARY OUTPUT: Cape Town Offices (after third iteration)								
<i>Regression Statistics</i>								
Multiple R	0.833206594							
R Square	0.694233228							
Adjusted R Squar	0.656012381							
Standard Error	2.764171973							
Observations	10							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	138.782662	138.782662	18.1637324	0.002754304			
Residual	8	61.12517359	7.640646698					
Total	9	199.9078356						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	42.62465489	7.285152342	5.850894105	0.00038239	25.8250526	59.42425718	25.8250526	59.42425718
CAP	-2.84328442	0.667141194	-4.261893054	0.002754304	-4.381715766	-1.304853073	-4.381715766	-1.304853073
SUMMARY OUTPUT: Cape Town Industrial sites (second iteration)								
<i>Regression Statistics</i>								
Multiple R	0.991172949							
R Square	0.982423814							
Adjusted R Squar	0.968362866							
Standard Error	1.356980633							
Observations	10							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	4	514.6257998	128.6564499	69.86895776	0.000141544			
Residual	5	9.20698219	1.841396438					
Total	9	523.832782						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	82.52672819	15.73551672	5.244615074	0.003341064	42.07736083	122.9760956	42.07736083	122.9760956
PE_JSE	-1.023540443	0.461043354	-2.220052485	0.077123162	-2.208688177	0.161607291	-2.208688177	0.161607291
NINFL	-1.583273677	0.18580348	-8.521227227	0.00036623	-2.060895948	-1.105651405	-2.060895948	-1.105651405
ACDC	2.041467534	0.157562424	12.95656338	4.88122E-05	1.63644109	2.446493978	1.63644109	2.446493978
CAP	-4.130375421	0.869015158	-4.752938291	0.005091224	-6.364246351	-1.89650449	-6.364246351	-1.89650449

B. Pretoria

SUMMARY OUTPUT: Pretoria Offices (after second iteration)

<i>Regression Statistics</i>	
Multiple R	0.943528264
R Square	0.890245585
Adjusted R Square	0.751526283
Standard Error	3.009074854
Observations	10

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	2	587.5486027	293.7743013	32.44500305	0.000288074
Residual	8	72.43625181	9.054531477		
Total	10	659.9848545			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
DISPINC	3.531270899	0.754617745	4.679549244	0.001582802	1.791118133	5.271423666	1.791118133
GRM2	0.793139142	0.172583407	4.595685978	0.001765383	0.395160835	1.191117449	0.395160835

C. Bloemfontein

SUMMARY OUTPUT:
Bloemfontein Retail (after
second iteration)

<i>Regression Statistics</i>	
Multiple R	0.8518868
R Square	0.7257111
Adjusted R Square	0.691425
Standard Error	4.2146871
Observations	10

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	375.989942	375.98994	21.16633	0.001753875
Residual	8	142.108696	17.763587		
Total	9	518.098638			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	6.4466024	1.72352933	3.7403497	0.0057025	2.472134043	10.421071	2.472134	10.421071
RETSALES	1.3965139	0.30354459	4.600688	0.0017539	0.696538412	2.0964895	0.6965384	2.0964895

APPENDIX 4: STATISTICAL METHODS AND TECHNIQUES

A4.1. Least squares multiple linear regression

Least squares multiple linear regression is a statistical method that are widely used in natural and economic sciences. The method attempts to describe a single response or dependent variable using more than one explanatory or independent variable (Wisniewski, 2002:347). The least squares multiple linear regression method was used within this study to describe the required rate of return in terms of several explanatory variables from categories from the capital market returns, alternative investment opportunities, economic variables and property market fundamental parameters.

The statistical model for a multiple linear regression is

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip} + \epsilon_i \quad \text{for } i = 1, 2, \dots, n.$$

The proportion of variation of the dependent variable y_i that is explained by the independent variables x_1, x_2, \dots, x_p in a multiple linear regression is denoted by the squared multiple correlation, R^2 . The R^2 parameter can take on a value of between 0 and 1. However it is not sufficient to only consider the value of R^2 to determine goodness of fit or reliability of the model. Therefore the so-called F-test, which is a hypothesis test of R^2 , needs to be applied in addition to the assessment of R^2 . With such a test one formulate H_0 as follows: the β terms in the above equation are not statistically different from zero.

That is:

$$H_0: \beta_0 = \beta_1 = \dots \beta_n = 0$$

If, at the end of the hypothesis test one rejects H_0 , it implies that at least one of the x_i variables is statistically significant and if one fail to reject the null hypothesis, it implies that none of the x_i variables are significant. In other words, y_i is statistically not dependent on the x_i variables and the estimated model or equation is not reliable. The

It's frequently the case that multiple regression requires an iterative process and it is not often that the first attempt produces the optimal regression model to describe data. In practical terms this implies that the statistical tests of integrity of the model often deem some of the independent variable(s) X_j statistically insignificant which requires adjustment of the model. It is thus useful to consider an ANOVA or Analysis of Variance statistic for the data set under consideration for assessment of the overall fit of the model.

The four key assumptions behind this regression model that needs to be checked are (Wisniewski, 2002:356):

1. There is a linear relationship between dependent (y) and the independent (x) variables. Scatter plots can provide a means to test linearity and dependence before the regression process is started. The process can also be shortened if many variables need to be tested by calculating the coefficient of regression for each independent variable against the dependent variable in turn. A programs such as MS Excel has built in functions to perform this task.
2. The regression errors have a constant variance i.e. that the difference between the actual y value and the y value predicted remains approximately constant over the entire range of data. Once again, scatter plots can be used to test this assumption.
3. The regression errors are independent of each other or that each error is independent of the errors before it and if this assumption is not met autocorrelation exists. *Durbin and Watson* devised a test that can be used to study this assumption.
4. The x variables are independent of each other i.e. the equations are multi-collinear. A correlation matrix, that express the correlation coefficient between and thereby allow to quantify multi-co-linearity between the independent (x) variables, can be used for such purpose.

All of these assumptions need to be tested prior to undertaking a multiple linear regression on a data set. (The multiple linear regressions and ANOVA in this study were done with the MS Excel statistical software package.)

A4.2 F-test

The significance of differences in results of a regression can be evaluated and the appropriate statistical tests be done to ensure that the models were valid and representative of the information. The F -distribution can be used to test the equality of two variances. Suppose

$$X_1 \sim N(\mu_1, \sigma_1^2)$$

$$X_2 \sim N(\mu_2, \sigma_2^2)$$

And it is required to test whether the two variances are equal that is if

$$H_0 : \sigma_1^2 = \sigma_2^2 \text{ against the alternative hypothesis that}$$

$$H_1 : \sigma_1^2 \neq \sigma_2^2$$

Let $\sigma^2 = \sigma_1^2 = \sigma_2^2$ be the common variance under the null hypothesis. Suppose X_1 is sampled with sample size n_1 , and has unbiased estimate of sample variance s_1^2 and X_2 is sampled with sample size n_2 and unbiased sample variance s_2^2 . Then

$$\frac{(n_1 - 1)s_1^2}{\sigma^2} \sim \chi_{n_1 - 1}^2 \text{ and } \frac{(n_2 - 1)s_2^2}{\sigma^2} \sim \chi_{n_2 - 1}^2$$

Since

$$F_{\nu_1, \nu_2} = \frac{\chi_{\nu_1}^2 / \nu_1}{\chi_{\nu_2}^2 / \nu_2}$$

Substituting $\frac{(n_1 - 1)s_1^2}{\sigma^2}$ for $\chi_{\nu_1}^2$ and $n_1 - 1$ for ν_1 and $\frac{(n_2 - 1)s_2^2}{\sigma^2}$ for $\chi_{\nu_2}^2$ and $n_2 - 1$ for ν_2 we obtain

$$F_{n_1 - 1, n_2 - 1} = \frac{\left(\frac{(n_1 - 1)s_1^2}{\sigma^2 (n_1 - 1)} \right)}{\left(\frac{(n_2 - 1)s_2^2}{\sigma^2 (n_2 - 1)} \right)} = \frac{s_1^2}{s_2^2} \text{ or in other words the } F \text{ distribution with } n_1 - 1 \text{ degrees of}$$

freedom in the numerator and $n_2 - 1$ degrees of freedom in the denominator is equal to the ratio of unbiased estimates of the sample variance for the two samples, the first of size n_1 , the second of size n_2 . We have the convention that the sample size with the larger variance is always given the value in the numerator. This means that we will always obtain a ratio greater than 1. The closer the value of F is to 1, the less likely it is

that the variances are equal. Hence, there will be a critical value of F for a given significance level that if the ratio of $\frac{s_1^2}{s_2^2}$ is exceeded, it will indicate that the two variances are not equal at that significance level.