

ANALYSIS OF MULTI-STAGE REAL OPTIONS FOR TIMING REDEVELOPMENT OF
SUPER REGIONAL SHOPPING CENTRES IN SOUTH AFRICA, UTILIZING STUDY
AREA JOHANNESBURG WEST REGION C

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A dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Science in Building.

Johannesburg, 2014

DECLARATION

I declare that this dissertation is my own unaided work. It is being submitted to the Degree of Master of Science in Building to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

Signature:

..... day of,

ABSTRACT

With changing supply and demand economic conditions which may be unfavourable, it is imperative that investors time redevelopment of a property asset in order to maximise profitability. When correlating the relationship between capital values and vacancy rates of super regional shopping in South Africa between the years 2003 – 2012 there is a positive correlation, meaning that investors are not adequately timing the redevelopment of super regional shopping centres in order to maximum profitability.

This research utilizes multi-stage real options to time redevelopment of shopping centres in order to maximise profits, through the analysis of supply and demand economic variables; and the Black-Scholes Model.

The research methodology of the study ensured that the research results utilized were thoroughly investigated and tested through reliability and validity testing measures; and that the data collected was harvested from credible and reputable databases such as the Investment Property Databank Limited, Statistics South Africa and the City of Johannesburg.

DEDICATION

I dedicate this study to the Lord Almighty, my parents Zacharia and Morakane Mogodi; and to my siblings Mashikoane and Keitumetse Mogodi.

ACKNOWLEDGEMENTS

I would like to thank Mr Nalumino Akakandelwa for his support and encourage through this journey; and the School of Construction Economics and Management for their never ending faith in me.

I appreciate the assistance of the following databases:

- Investment Property Databank Limited
- Economic Analysis unit of SRM, Gauteng Provincial Government
- City of Johannesburg

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LIST OF ACRONYMS

BRICS:	Brazil Russia India China South Africa
CBD:	Central Business District
CPI:	Consumer Price Index
DCF:	Discounted Cash Flow
EWDC:	East West Development Corridor
GDP:	Gross Domestic Products
IPD:	Investment Property Databank Limited
IRR:	Internal Rate of Return
JMPD:	Johannesburg Metropolitan Police Department
JRA:	Johannesburg Road Agency
NMT:	Non-Motorised Transport
NPV:	Net Present Value
Soweto:	South Western Township
Stats SA:	Statistics South Africa
YoY:	Year on Year

CHAPTER 1

INTRODUCTION

1.0 Opening

*“Birth, growth, maturity, decline -shopping centers are as prone to life forces as the rest of us.
Developers and retailers should plan accordingly.”*

(Lowry, 1997)

James Lowry highlights that shopping centres are not immune to economic and financial decline as they are subject to life changes as time progress, similarly to human life. However, it is up to investors to devise strategic interventions in order to manage and profit from the life cycle of shopping centres.

The study reveals how investors can time redevelopment in order to maximise profitability of super regional shopping centre in South Africa. The study considers the examination of supply and demand economic variables for the use of multi-stage real option, on study area Johannesburg West Region C.

1.1 Background of the Study

In the past 15 years (1998 – 2012) the retail sector in South Africa has contributed an average of 11% towards the country’s GDP (Statistics South Africa (Stats SA) and Liberta, 2013). This is an indication that retail plays an important part in the country’s economy. Stats SA (2013) reported that retail sales in South Africa increased by 2.30% in December of 2012 compared to the same period in the previous year, December 2011. Stats SA further revealed that year on year retail sales averaged 5.6% between the years 2004 and 2012 then reaching an all-time high of 15.4% in September of 2006 (Trading Economics, 2012). These statistics state that products in the retail sector are easily transacted and can translate into profits.

According to the Investment Property Databank Ltd (2013), the South African Retail Trading Index for super regional shopping centres had one of the highest retail trading indices for the 4th quarter ending December 2012. Trading statistics indicated that super regional shopping centres

out-performed regional centres by 13.46% and small regional centres by 5.77%. Although these statistics creates a positive perspective for super regional shopping centres investors. Would an economic analysis of super regional shopping centres in South Africa prove that super regional shopping centre investors' are not maximising profits due to inadequate timing of redevelopment?

The consideration of supply and demand economic factors is imperative for the survival of shopping centres (Thomsett, 2005). Thus far, South Africa has 8 super regional shopping centres and between the years 2003 to 2012 there have been no additional super regional shopping centres built (Economic Analysis Unit of SRM. 2012). However, when correlating the relationship between capital values and vacancy rates of super regional shopping in South Africa between years 2004 – 2012 there is a positive correlation, meaning that when capital values of super regional shopping centres increase vacancy rates of super regional shopping centres increase; and when capital values of super regional shopping centres decrease vacancy rates of super regional shopping centres decrease for the same period in South Africa (Investment Property Databank Ltd, 2012 and Appendix C).

This relationship is not ideal because when capital values of super regional shopping centres increase, vacancy rates of super regional shopping centres should decrease; and when capital values of super regional shopping centres decrease, vacancy rates of super regional shopping centres should increase for the same period indicating maximum profitability (Warren, 2000). Therefore, this means that there should be a negative correlation between capital values and vacancy rates of super regional shopping centres for the same period.

This economic analysis is an indication that super regional shopping centres investors are not maximising profits due to inadequate timing of redevelopment and prones the study to investigate the use of multi-stage real options which takes supply and demand economic factors into consideration in order to determine the appropriate time to redevelop super regional shopping centres in South Africa to maximise on profits.

To apply the investigation in practice; the research utilises study area of Johannesburg West Region C, due to the fact that the region has one of the eight super regional shopping centre that form part of the harvested information.

1.2 Brief Literature Review

A shopping centre's life may end not because of physical deterioration but for economic and financial reasons that the revenue generated falls below the operating costs. The ideal time for redevelopment is when the present value of expected future returns from the existing building becomes less than the current value of clearing the site (Sirmans, 1995). Redevelopment occurs when the marginal revenue product of redevelopment exceeds the costs of demolition and reconstruction of the building to a higher density (or higher quality); and the "irreversibility" premium of not waiting for more information (Patel et al., 2005). Conventional approaches to redevelopment focus on the net present value (NPV) of buildings. However, the NPV decision rule cannot determine the appropriate time for redevelopment and ignores the dynamic economic changes in supply and demand (Ott, 2002).

Real options present an approach that allows investors to time redevelopment, in order to maximise profitability (Abina, Comlin, Nadeau, Smetane, 2008). A real option is a right and not an obligation to invest in a real asset in the future that gives an investor the opportunity to acquire, develop, redevelop or dispose of a real asset at an investment cost estimated at present relative to deliverable future benefits (Patel et al., 2005). All real options give an investor the opportunity to create, execute and abandon development or redevelopment; (Mun, 2006) in order to cater for uncertainty (Greden and Glicksman, 2005). There are a number of options types which are applicable to real estate including options to delay, expand or contract, shut down, abandon, and to stage investment in response to changing supply and demand economic factors (Patel et al., 2005, Kemna, 1993, Trigeorgis, 1993, Lucius, 2001). Redevelopment options, focus on the use of analytic framework and numerical models to analyse the effect of multi-stage redevelopment on the value of a built property (Williams, 1997).

Several authors have written about the benefits (Lucius, 2001, Parthasarathy and Madhumathi, 2010, Sing, 2001, Guthrie, 2009) as well as importance of applying real option analysis to real estate projects (Damodaran, 2005). However, real option application in real estate has largely focused on delay options to develop vacant land. Options of timing redevelopment have not been extensively investigated in application; hence this study explores the application of multi-stage real options on the redevelopment of super regional shopping centres in South Africa utilizing study area, Johannesburg West Region C.

1.3 Research Question

Would the use of multi-stage real options determine the appropriate time for redeveloping super regional shopping centres in South Africa in order to maximise profits, utilising study area Johannesburg West Region C?

1.4 Problem Statement

Changes in supply and demand have affected the economic and financial viability super regional shopping centres. In the last 10 years (2003 – 2012) there have been no additional super regional shopping centres built in South Africa (Investment Property Databank Ltd, 2013). However, despite existing super regional shopping centres under going redevelopment the capital value of super regional shopping centres has decreased from 18.99% to 11.81% and; vacancy rates of super regional shopping centres have increased from 0.9% to 2.6% between the years (2007 and 2012) (Investment Property Databank Ltd, 2013). This analysis means that super regional shopping centre investors in South Africa are faced with a challenge of deciding how to time redevelopment in order to maximise profits.

Multi-stage real options (Chiang, So and Yeung, 2006 and; Guthrie, 2009) give an investor the opportunity to time future redevelopments in order to maximise profits, subsequent to gathering information about changes in supply and demand in the economic environment.

There are methods of determining the approximate value of a property once it has been redeveloped, predominantly the Discounted Cash Flow (DCF) analysis, Net Present Value (NPV) and the Internal Rate of Return (IRR) (Sayce, Smith, Cooper, Venmore-Rowland, 2006). However, these methods of appraisal fail to take into consideration the appropriate time for redevelopment that achieves maximum profitability.

With the use of study area Johannesburg West region C, the study utilizes multi-stage real options analysis that take into consideration economic changes of supply and demand; in order to determine the appropriate time for redeveloping super regional shopping centre in South Africa to maximize profits.

1.5 Aim and Objectives of the Study

The aim of the study is to establish the appropriate profit maximizing timing strategy for redeveloping super regional shopping centres in South Africa through multi-stage real options, which takes into consideration economic changes in supply and demand on study area, Johannesburg West Region C.

The objectives of the study are as follows:

- a) To identify supply and demand economic factors for redevelopment of super regional shopping centres in South Africa, utilizing study area Johannesburg West Region C.
- b) To examine changes in the supply and demand economy for the redevelopment super regional shopping centres in South Africa, utilizing study area Johannesburg West Region C.
- c) Utilising the Black-Scholes Model and; examined economic changes in supply and demand, to determine the appropriate time for redeveloping super regional shopping centres in South Africa using multi-stage real options in order to maximise on profits, utilising study area Johannesburg West Region C.

1.6 Research Methodology

1.6.1 Type of Study: Empirical study

The type of research is identified as an empirical study, due to the fact that the study analysis historical statistical and theoretical data.

1.6.2 Type of data

The study relies on published data from international and local authors to establish the appropriate profit maximizing timing strategy for redeveloping super regional shopping centres in South Africa through multi-stage real options which takes into consideration economic changes in supply and demand, on study area Johannesburg West Region C.

1.6.3 Measured Variables

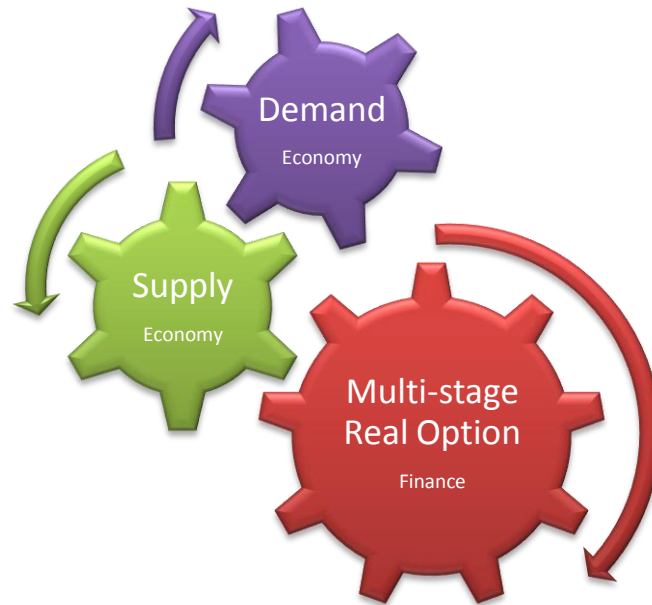


Figure 1.1 Analysis of Supply, Demand and Multi-stage Real Options Variables

Source: Author (2013)

Figure 1.1 illustrates that the supply, demand and multi-stage real options variables were examined in the study. Furthermore, the figure explains that supply and demand economic variables are instrumental for the financial use of multi-stage real options.

1.7 Scope, Assumptions and Limitations

1.7.1 General Scope of the Study

The study is confined to super regional shopping centres in South Africa and multi-stage real options which takes into consideration changes in the supply and demand economy to establish the appropriate time for redeveloping super regional shopping centres in South Africa.

1.7.2 Assumptions

It is assumed that:

- the analytic framework for redevelopment real option is valid and reliable,
- existing shopping centre developments have approved planning permission for redevelopment, architectural flexibility and legal limitations,
- there are no special interests by investors that would influence revenues and/or operation costs,
- financial information is credible.

1.7.3 Limitations to the Study

The following are limitations to the study due to the fact that these areas conform to the research requirements:

- Super regional shopping centres in South Africa and not including regional, small-regional and community shopping centres.
- Study area Johannesburg West Region C as indicated on Appendix A, which is one of seven administrative regions that form part of the City of Johannesburg. The region is situated to the north-western side of Johannesburg (CBD), to the north of Soweto and bordering Mogale City Local Municipality to the west (City of Johannesburg 2010).
- Multi-stage real options for the use timing redevelopment.

1.8 Justification of Study

Real options method offers investors' opportunities to time redevelopment by analysing the capital value of property, the purchase price of property if it were to be sold, probability to redevelop, the compensation for systematic risk which cannot be eliminated by holding a diversified portfolio and the standard statistical analysis of measuring demand and supply economic variables considered for redevelopment (Benninga and Czaczkes, 2000). The benefit of super regional shopping centre investors' focusing on multi-stage real options for the timing

redevelopment of super regional shopping centres is that, they would apply strategic decisions making.

1.9 Chapter Outline

Chapter 1 covers the introduction, background of the study, brief review of literature used to develop the problem statement, aim and research objectives, methodology, scope, limitations as well as the justification of the study.

Chapter 2 analyses content and statistical literature on changes in the supply and demand economy applicable for super regional shopping centre redevelopment in South Africa and relates findings to study area, Johannesburg West Region C.

Chapter 3 examines the research methodology of the study which covers the research strategy, data analysis and type of data collected.

Chapter 4 presents research results, analysis and interpretation with the use of the Black-Scholes Formula and examined supply and demand economic variables in Chapter 2 for the application of multi-stage real options analysis on super regional shopping centres in South Africa, utilizing study area Johannesburg West Region C.

Chapter 5 concludes the study and makes recommendations for implementation of multi-stage real options on super regional shopping centres in South Africa with the use of study area, Johannesburg West Region C. Furthermore based on the findings, this section of the study elaborates on future recommendations and contribution of the study to the body of knowledge.

CHAPTER 2

LITERATURE REVIEW ON SUPPLY AND DEMAND ECONOMIC VARIABLES

Urban real estate markets may be peculiar and idiosyncratic in a number of respects, but they still obey some basic economic principles: the principles of demand and supply.

(Featherstone, 1986)

2.0 Introduction

Super regional shopping centres, have the widest and deepest product mix and attract customers both near and far from its location (Pride and Ferrell, 2011). Their main attraction for shoppers includes sophisticated stores and/or Unique Selling Products (USP) such as skating rinks, arcades and up-scale restaurants.

In order to manage economic decline super regional shopping centres are often faced with the challenge of redevelopment. As stated by (Featherstone, 1986) supply and demand governs and partakes a fundamental role in economy; and therefore these factors would be imperative for redevelopment of super regional shopping centres. In general, the retail market is sensitive to supply and demand economic changes due to the influence they have on profitability (Brounen, 2003). In the study context, supply is concerned with providing the required quantity of development or redevelopment of a retail asset to meet consumer demand (Pride and Ferrell, 2011). Due to the fact that economic forces of supply and demand continually interact in any market (Lank, 2004), the study analysis supply economic factors on a macro, meso and micro level of analysis; and demand economic factors on a macro level of analysis.

The purpose of the chapter is to identify and examine factors of supply and demand required to time redevelopment of super regional shopping centres in South Africa in order to maximise profit, on study area Johannesburg West Region C.

2.1 Factors that affect Supply

The purpose of figure 2.1 is to identify and explore factors that affect supply on a macro, meso and micro level of analysis.

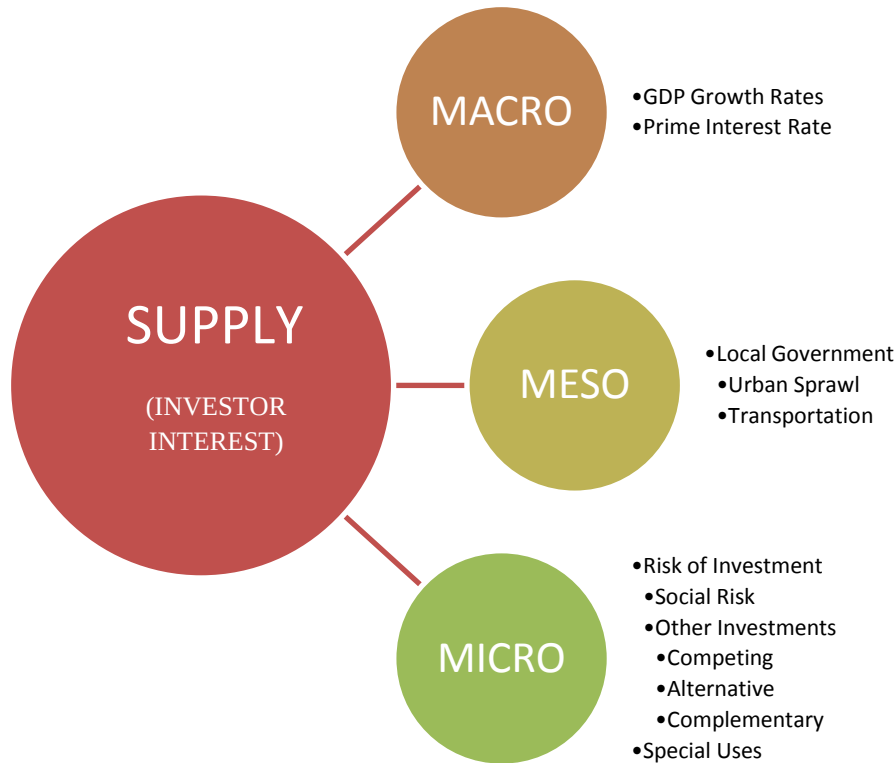


Figure 2.1: Supply Economic Variables Analysis

Source: Author (2013)

Figure 2.1 reveals GDP growth rates and prime interest rate are the main determinates that affect the decision to redevelop super regional shopping centres in South Africa on a macro level of analysis, while the local government is the main influencer on a meso level of analysis as they have insight and control measures over urban sprawl and transportation issues in Johannesburg West Region C. The micro level of analysis focuses on the immediate business environment that would impact investors of super regional shopping centres in study area Johannesburg West Region C which are; risk of investment (social risk and other investments namely competing, alternative and complementary) and special uses.

2.2 Supply and the Macro, Meso and Micro Economic Analysis

Supply in this context can be defined as the quantity of a development or redevelopment that a current or future investor is willing and able to provide onto the market at a given development or redevelopment cost in a given time period (Wilkinson and Reed, 2010). To understand and investigate changes in the supply economy for the use of timing redevelopment of super regional shopping centres in South Africa the study examines the; macro, meso and micro level of analysis with the application of study area Johannesburg West Region C.

2.2.1 Macroeconomic Analysis: GDP growth rates and Prime Interest Rates

Macroeconomic factors are characterised as major external and uncontrollable factors that influence an organization's decision making, and affect its performance and strategies.

(Jain, Trehan and Trehan, 2011).

While much of the world staggered in the wake of the global financial meltdown, South Africa has managed to stay afloat due to strict monitoring of macroeconomic factors such as GDP growth rate and prime interest rate (South African Info reporter, 2013). Ranked by the World Bank as an upper middle-income country, South Africa is the largest economy in Africa and due to its stable economy South Africa was admitted to the Brazil, Russia, India and China (BRICS) group in 2011 (South African Info reporter, 2013). This fertile state of the economy has resulted in a significant growth of new supply of retail developments in the years 2005 - 2012 (Hedley, 2013). Thus far the retail property market continues to flourish, however retail property analysts believe that at some point, returns in the retail property market will decline if rental growth continues to match retail turnover growth over time (Anderson, 2013). Although, they foresee regional and super regional centres likely to remain stable through the predicted income decline, while smaller community and neighbourhood centres, will probably encounter lower expected returns (Anderson, 2013). This analysis deduces that super regional shopping centres should not have a problem sustaining long-term economic growth even through depression, thereby sustaining economically resilient capital values.

Capital value in terms of an income producing property context is defined as the worth of an asset calculated in terms of the profit it generates (Korobkin, 2011). Shopping centres generate profits through sales of merchandise by tenants (Cirz, 2012). However, before any income producing property can have the ability to make sales; investors have to acquire funds for development or redevelopment of the property. Investors normally rely on financial institutions for funds due to the large resource demand (Mishkin and Eakins, 2009); and if they do acquire funds from financial institutions they are normally charged a fee for borrowing funds termed an interest rate (O'connor, 2001)

This section of the study uses scatter chart analysis in the form of figure 2.2, 2.3, 2.6, 2.7, and; descriptive and inferential statistics to analyze supply macroeconomic variable; GDP growth rates and prime interest rates in relation to capital values of super regional shopping centres in South Africa. The reason why the study uses capital values of super regional shopping centres as a measure of GDP growth rates and prime interest rates is because capital values represent the worth of an asset as a result of the income it produces once it has been built or redeveloped (Ling and Archer, 2012).

GDP Growth Rates

GDP growth rates are defined by the monetary value of all final goods and services produced in a country within a given time period, which is expressed in percentage (Tucker, 2010).

South Africa experience one of the lowest GDP growth rate figure of -6.30% in the 2009 global recession (Liberta, 2013). During the same period the average annual growth of the retail industry in South Africa was 0% which is low compared to the average 4% expected annual growth Economic Analysis Unit of SRM (2012). This observation leads the study to investigate whether there is a relationship between GDP growth rates and the redevelopment of super regional shopping centres in South Africa and; whether the resultant relationship is significant for the redevelopment of super regional shopping centres in South Africa.

In order to investigate this phenomena, the relationship between changes in GDP growth rates and changes in capital values of super regional shopping centres in South Africa, are analysed

utilizing a Figure 2.2 and correlation coefficient analysis, from the years 2003 to 2012 on a year lag.

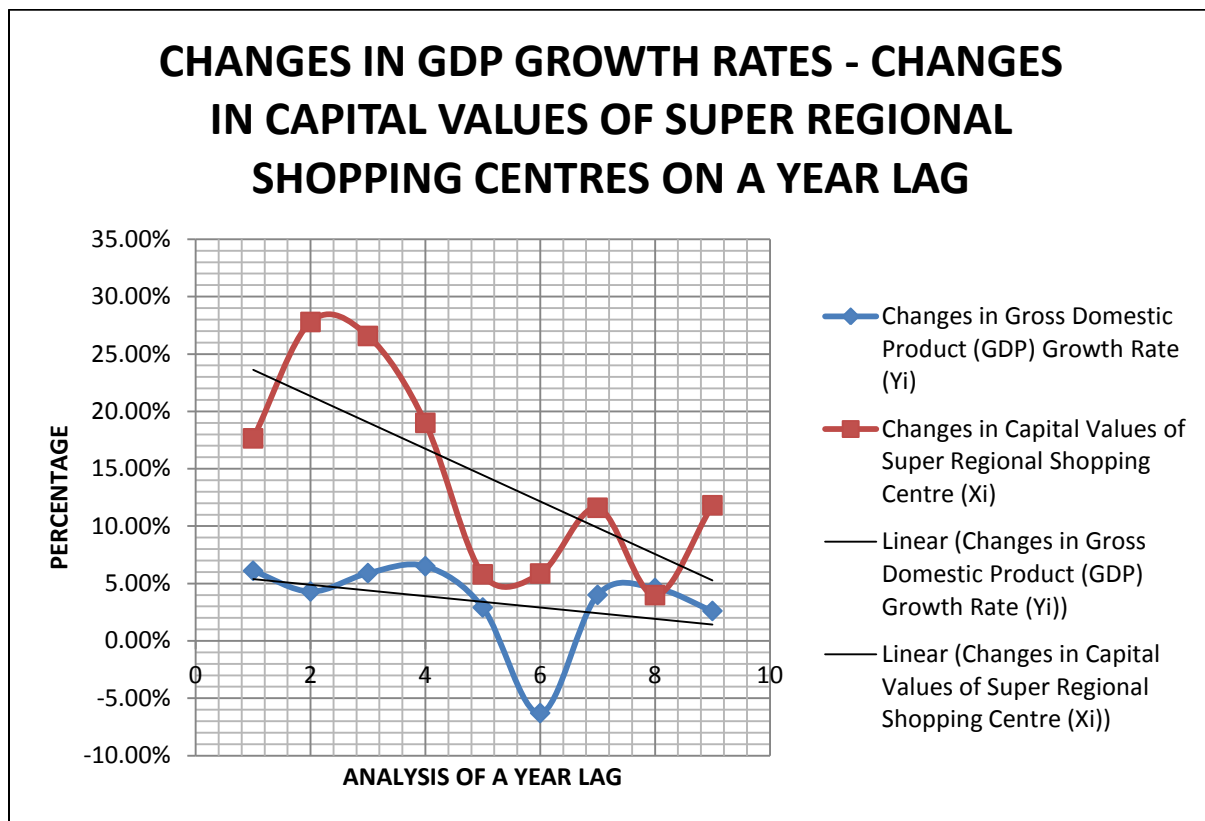


Figure 2.2: Changes in GDP Growth Rates and Changes in Capital Values Super Regional Shopping Centres on a Year Lag

Source: Investment Property Databank Ltd (2013), Liberta (2013) and Appendix B (2014)

Figure 2.2 represents the relationship between changes in GDP growth rates and changes in capital values of super regional shopping centre, on a year lag. The figure reveals that small values of changes in GDP growth rates have a significant impact on changes in capital values of super regional shopping centre, which is represented by the higher values of changes in vacancy rates of super regional shopping centre in relation to changes in GDP growth rates values. Furthermore, on analyses of the linear lines, the variables move in same direction meaning that when changes in GDP growth rates increase, changes in capital values of super regional

shopping centres increase; and when changes in GDP growth rates decrease, changes in capital values of super regional shopping centres decrease for the same period on a year lag.

This relationship is confirmed by the correlation coefficient value of 0.187 (Appendix C). The value further reveals that the relationship is weak due to the fact that the correlation lies within the 0 and 0.3 positive relationship interval (Ratner, 2004). The weak relationship means that there is a possibility that there is no relationship between GDP growth rates and capital values super regional shopping centres in South Africa.

Although GDP growth rates could be assumed as one of the most prominent economic factors affecting the redevelopment of super regional shopping centres, prime interest rate have an important role in sourcing the availability and value of funds.

Prime Interest Rate

Prime interest rate can be defined as the amount of money paid for the use of borrowed funds expressed in percentage (Hatten, 2011).

Interest rates have always been a major concern for investors because they regulate the availability of funds (Keown, Martin, Petty and Scott, 2003). From the first regional shopping centres development in the 1970's, shopping centre retail development in South Africa has rapidly increased even through one of the country's highest prime interest rate recorded of 25.50% in 1999 (Economic Analysis Unit of SRM, 2012 and Liberta, 2013). As a result the study is persuaded to investigate whether there is a relationship between prime interest rates and the redevelopment of super regional shopping centres in South Africa and; whether the resultant relationship is significant for the redevelopment of super regional shopping centres in South Africa.

In order to determine whether prime interest rates are significant for the redevelopment of super regional shopping centres in South Africa, the relationship between changes in prime interest rates and changes in capital values of super regional shopping centres in South Africa are investigated between the years 2003 to 2012 on a year lag. A scatter chart labelled Figure 2.3 is

used to visually analyse the relationship, and the bivariate correlation coefficient analysis is utilized for statistical analysis.

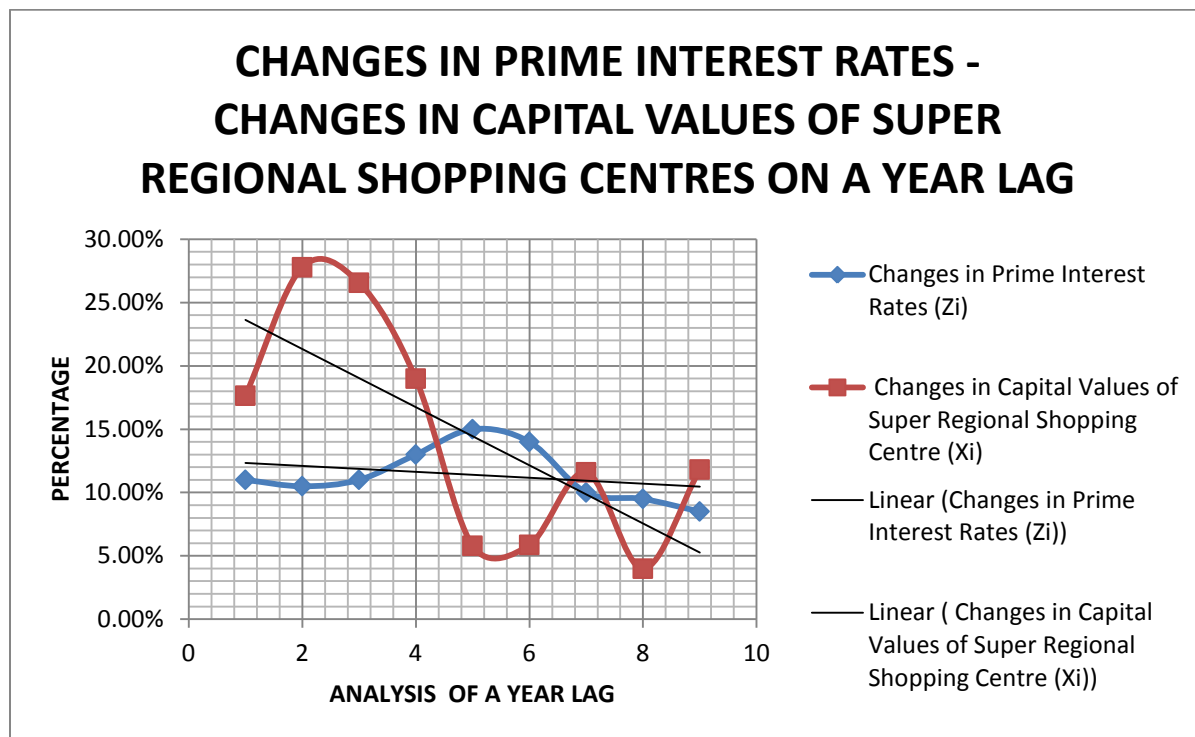


Figure 2.3: Changes in Prime Interest Rate and Changes in Capital Values of Super Regional Shopping Centres on a Year Lag

Source: Investment Property Databank Ltd (2013), Liberta (2013) and Appendix B (2014)

Figure 2.3 represents the relationship between changes in prime interest rates and changes in capital of super regional shopping centre, on a year lag. The figure reveals that changes in prime interest rates have a moderate impact on changes in capital values of super regional shopping centre, due to the fact that both variables have similar value changes. On analyses of the linear lines, the variables move in different direction meaning that when changes in prime interest rates increase, changes in capital values of super regional shopping centres decrease; and when changes in prime interest rates decrease, changes in capital values of super regional shopping centres increase for the same period on a year lag.

This relationship is confirmed by the correlation coefficient value of -0.242 (Appendix C). The value further reveals that the relationship is weak due to the fact that the correlation lies within the 0 and -0.3 negative relationship interval (Ratner, 2004). The weak relationship means that there is a possibility that there is no relationship between changes in prime interest rates and capital values of super regional shopping centre in South Africa.

Supply Variables Macro Economy Analysis

From both supply macroeconomic factors; changes in GDP growth rates and changes in prime interest rates in relation to changes in capital values of super regional shopping centre it is statistically evident that there is a weak relationship among the variables. The study further established that the relationship is so weak that there is a probability that there is no relationship among the variable.

In order to test whether or not there is a probability that there is no relationship between supply macroeconomic factors; changes in GDP growth rates and changes in prime interest rates in relation to changes in capital values of super regional shopping centre in South Africa. The study utilizes the null hypothesis testing which is expressed as follows:

$$H_0: \mu_1 = \mu_2$$

where:

H_0 Is the null hypothesis that states that there is no relationship between supply macroeconomic factors; changes in GDP growth rates and changes in prime interest rates in relation to changes in capital values of super regional shopping centres.

μ_1 Changes in GDP growth rates

μ_2 Changes in prime interest rates

From the above null hypothesis test equation; the changes in GDP growth rates and changes in prime interest rates are independent variables which are equal in the equation due to the weak correlation they share in relation to changes in capital values of super regional shopping centres

for the same period on a year lag. Therefore, the dependent variable is the changes in capital values of super regional shopping centres.

The two-way multivariate anova analysis was used to test whether or not there is a relationship between macroeconomic factors; changes in GDP growth rates and changes in prime interest rates in relation to changes in capital values of super regional shopping centres in South Africa. Within the multivariate analysis, the one-tail test was used to examine the variables due to the fact that it can determine whether or not the null hypothesis should be rejected (King, Rosopa and Minium, 2011).

The f value analysis was used to test the hypothesis in the study due to the fact that f value measures the relationship between variables by analysing the interaction between columns and rows of sampled variables with the use of degree of freedom for each variable (Pruim, 1999). The study used a p-value of 0.05 to test the hypothesis because it is the accepted research standard for 3 variable analysis (Lavrakas citing Noymer, 2008). The results were as follows:

Table 2.1 illustrate how these measurable relate to the resultant hypothesis:

MULTIVARIATE ANOVA ANALYSIS				
Null Hypothesis Testing	Numerator Degree of Freedom	Denominator Degree of Freedom	Required F-Value to Reject Null Hypothesis	Resultant F-Value
Relationship Between Variables	$(3 - 1) = 2$	$(9 - 1) = 8$	$f < 4.46$	3.37
Result: Reject the Null Hypothesis because $f < 4.46$				

Table 2.1: Supply Macro Economic Variables Analysis

Source: Author (2013)

The results yielded a f-value of 3.37 (Appendix D), which means that the test rejects the null hypothesis H_0 that suggests that there is no relationship among macroeconomic factors; changes in GDP growth rates and changes in prime interest rate in relation to changes in vacancy rates of super regional shopping centre. This is due to the fact that the resultant f-value of 3.37, is lower than the f-value of 4.46.

It is statistically evident that though the relationship between supply macroeconomic factors; changes in GDP growth rates and changes in prime interest rates in relation to changes in capital values of super regional shopping centres in South Africa weak there is a 95% probability that there is a relationship. Therefore, this means that supply macroeconomic factors may be significant in the redevelopment of super regional shopping centres in South Africa.

To follow, the study analysed the supply meso and micro economic analysis.

The supply meso economic analysis identifies and explores regulatory and governance issues affecting the study area while, the microeconomic analysis evaluates the riskiness, other investments and obstacles' that may impact the study area.

In Johannesburg West Region C, the local government is the main body that regulates and governs the region on a meso economic level.

2.2.2 MESO ANALYSIS: THE LOCAL GOVERNMENT

Meso analysis can be defined as a level of analysis that links macro and micro economic opportunities by shaping the framework of businesses or organisations through policies, procedures, rules and guidelines (Shaw, 2011). The local government can be defined as a body within an organization that has the authority and function to make and enforce laws, regulations or rules (Agard, 2010). The City of Johannesburg local government (2010) exercises power and authority over Johannesburg West Region C and has identified the following deficiencies within the region:

- Sprawling of informal settlements located in the southern and northern parts of the region and,
- Lack of public transportation with specific reference to the northern and central areas of the region.

The outlined issues are imperative to the survival of shopping centres as they promote a loyal customer base, contribute to efficient accessibility of a shopping centre and increase the number of shoppers. The study discusses the identified paucities in detail.

Urban sprawl

Urban sprawl can be defined as an uncontrollable and disproportionate expansion of cities and towns (Schultink, Memon and Thomas, 2005). In the last 10 years, the sprawling of informal settlement in Johannesburg West Region C context can be described as uncontrolled and disproportionate expansion of shacks, flats, houses, units, plots and dwellings, forming low-density, poorly planned patterns of development and often characterized by a scattered population living in separate residential areas with poor access to commercial activity (Sakowicz, 2004). The City of Johannesburg (2010) has identified 23 informal settlements located in the southern and northern parts of the region including the Ruimsig informal settlement which covers an area of 5.2 hectares, situated in the heart of middle to upper class residential area (Bolnick, 2011).

Informal settlements are a deterrent to investors because they weaken an area's economic position and deter affluent consumers due to health and safety issues (Tsenkova, 2010).

In order to eradicate the problem City of Johannesburg (2010) has implemented an intense strategy which involves building low-income housing in the identified areas; and has achieved the following results:

Name of Area	Number of Informal Units	Achieved Development Status
Matholeville Proper,Ext1& 2	701 plots and +-400 shacks	232 houses built. Development is ongoing.
Thulani	650 dwellings	30 houses built. Development ongoing.
Roodepoort social housing	450 Dilapidated RDP units	All houses have been revamped. Project completed.
Zandspruit Ext 9 & 10	767 dwellings	100 RDP units completed. Development is ongoing.

Table 2.2: Progress on the Completion of Low-Income Housing

Source: City of Johannesburg (2010)

Table 2.2 explains that although the local government is providing housing for informal settlers there are still a significant amount of people without formalised housing as development is still ongoing.

In addition, the lack of public transport services in the region has become a problem for people accessing local amenities including shopping centres (City of Johannesburg, 2010). Inhabitants living in the area complain that the transportation system is not efficient and reliable, however transport providers protest that there is a lack of passenger loyalty and more people are using private vehicles (Department of Transport, 2013). This information deduces that the local government has to formulate a strategic approach to inadequate transportation in order for all stakeholder involved to benefit from public transportation.

Transportation

Transportation is defined as a conveyance system used to carry people and goods from one place to another (Mineiro. 2011). The City of Johannesburg (2010) identified lack of public transport in this region as one of the main issues that prevent inhabitants from accessing further urban opportunities. Thus far, severe road capacity problems exist in the Wilgespruit and Northriding areas as a result of Greenfield developments mainly on provincial roads such as Beyers Naude, K72, Christiaan de Wet/Northumberland and Malibongwe Drive (City of Johannesburg, 2010). Furthermore, lack of north-south linkages to the south of the region results in fragmented, poorly accessible settlements (Coetzee, 2011).

In order to alleviate the problem, the Transport Department (2013) has implemented the Strategic Integrated Transport Plan Framework for the City of Joburg which is responsible for transport planning, policy development, project implementation and services which include support walking, cycling and public transport.

The policy includes nine thrusts that encompass the current state of public transport, objectives, strategies and programmes that will be pursued in order to promote an efficient transport system, both short term (next five years) and long term (to 2040).

The nine thrusts are as follows:

- Thrust no. 1: Restructuring and integrating the city.
- Thrust no. 2: Improving and expanding provision of quality public transport and use of non-

motorised transport.

- Thrust no. 3: Maintaining, improving, extending and integrating transport infrastructure.
- Thrust no. 4: Supporting economic growth through improving freight mobility.
- Thrust no. 5: Managing congestion, travel demand and parking.
- Thrust no. 6: Actively engaging citizens in improving the transport system.
- Thrust no. 7: Transforming the transport sector and encourage new, efficient and profitable transport enterprises and employment creation.
- Thrust no. 8: Planning and regulating the transport system.
- Thrust no. 9: Resourcing and financing the transport plan.

Thus far, the Department of Transport (2013) has promoted the following initiatives which can be explained in Table 2.3.

Mode of Transport	Consumers Demand	Advantages	Disadvantages	Applicable Areas/ Routes
Metro Rail	High to very high passenger demand (Used by 30 000 to 80 000 passengers per day)	*High commercial speeds (28 - 35 kilometres per hour) *Attracts discretionary public transport users *Uses relatively little public space *Low local air emissions *Superior image for the city	*Long development and construction times *Very high infrastructure costs *Poor revenue recovery during off-peak *Complex integration with feeder services	*Florida *Georgina *Hamburg *Horison *Princess *Roodepoort *Westgate. *Witpoortjie Station: Although it is located in Mogale City on the border of Region C, it does affect the region in terms of proximity and usage.
Bus Rapid Transport (BRT)	Low to high passenger demand (Used by 3 000 to 45 000 passengers per day)	*Good average commercial speeds (20-30 kph) *Ease of integration with feeder services *Moderately good image for city *Low infrastructure costs for exclusive right of way (compared to rail) *Low local air emissions	*Moderately high Infrastructure costs (compared to conventional bus/taxi) - R35 million/km in Johannesburg for bi-directional lanes excl stations *Require operating subsidy in Johannesburg conditions *Encroaches pre-existing bus lanes	*Main Reef Road *New Canada /Commando Roads *Elias Motsoaledi Road *Van Onselen Road *Ontdekkers Road. *Christiaan De Wet Road *Northumberland Road *Witkoppen Road. *Beyers Naude Drive *Malibongwe (Hans Strijdom) Drive
Conventional Bus (Metro bus/ Putco)	Low passenger demand (Used by 500 to 5 000 passengers per day) in mixed traffic	*Low infrastructure costs *Relatively low operating costs *Appropriate for small cities/corridors with low demand	*Gradually passengers are using private vehicles *Require operating subsidy in *Often lacking in basic customer amenities and comfort Johannesburg conditions	*Main Reef Road, *Ontdekkers Road, *Beyers Naude Drive *Malibongwe Drive
Minibus (Taxi)	Low to medium passenger demand (Used by 4 500 passengers per day – assuming one in eight vehicles on a two-lane per direction road are heading to the region).	*Low infrastructure costs *Small size allows more extensive door to door operation and more agile operation in traffic than conventional buses	*High number of vehicles because of small vehicle capacity which causes traffic pressures and more noise and air pollution than bigger modes of transport *Average commercial speeds same as mixed traffic	Checkers (Roodepoort), Roodepoort Station, Dobsonville Shopping Centre and Westgate Station are formalised taxi ranks in the region, however, there are a large number of informal taxi ranks throughout the region needing formalisation or relocation.

Table 2.3: Public Transport Decision Matrix

Source: Department of Transport (2013)

Table 2.3 suggests that at least 38 000 people commute in and around the city daily with a Living Standard Measure (LSM) of level 1-5. This population comprises 66.67% of Gauteng's adult population (Gauteng is the metropole that Johannesburg West Region C falls under) which are characterised by workers in sales, clerical, service and production industry (Higgs and Powell, 2006). The identified forms of transport in Table 2.3 commute in major routes in which most super regional shopping centres are located. The main form of public transportation is mini-buses (Taxis) which offer passenger transportation into smaller routes. In addition to daily users, the identified modes of transportation also attract discretionary public transport users.

There are other forms of movement by consumers that are also recognised and encouraged. The Department of Transport 2013) established the Non-Motorised Transport (NMT) policy in February 2008, which seeks to guide the planning and implementation of programmes and facilities for the multiple needs of NMT users. NMT includes all forms of movement that are human powered and do not rely on engines or motors for movement which includes walking, cycling, roller blades, skates, wheelchairs and animal-drawn. In Johannesburg, non-motorised forms of transport are predominantly represented by walking and cycling modes (City of Johannesburg, 2010). This brings investors to the realisation that super regional shopping centre developments must also be easily accessible for NMT and facilitate the identified movement in order to encourage a larger consumer catchment market.

2.2.3 MICRO ANALYSIS: RISK OF INVESTMENTS AND SPECIAL USES

Micro level of analysis refers to factors that influence the immediate area of operations that directly affects performance (Soobade, Cubbin, Gee, Rosenbaum and Laurenson, 2006.). The study identifies, the risk of investment and other investment as the main risks that impact study area, Johannesburg West Region C and they are explored as follows.

Risk of Investment

“One can not consider an investment without taking on risk. It comes complementary with the investment whether we acknowledge it or not. But through strategic management it can be minimised or controlled”

(Author, 2013)

The quote by the author entails that risk is inherent when there is a possibility to invest. The author further implies that though risk cannot be avoided, it can be mitigated or managed through tactical planning. However, if we analyse the word “complementary” in context; it suggests that the author views risk as a possible prospective.

Stoltz (2007) defines risk of investments as the probability or likelihood of occurrence of losses relative to the expected return on an investment. The study identified social risks and other investments namely competing, alternative and complementary investments as major risks. This section explores how the author’s quote applies in certainty using, study area Johannesburg West Region C.

Social Risk

Social risk can be defined as uncertain conduct or the actions of others that create vulnerabilities (Ayyub, 2011). The City of Johannesburg (2010) identified urban decay, poor law enforcement, weak stakeholder relationship and service delivery as major social issues in Johannesburg West Region C. Furthermore, the councillor of the region Willie van der Schyf (2013) describes the area as challenged by a decaying urban environment with issues such as illegal dumping, sanitation shortages, accessibility problems for law enforcement, emergency services, electricity theft and the illegal selling of land. He further stated that the Region C consists of 17 Wards however; only 8 Wards are recognised by the City of Johannesburg.

These dilemmas are mainly caused by the weak stakeholder relationship among its inhabitants, the government and business owners as there is no or little interaction between the parties making it complex to acquire and maintain common use resources (City of Johannesburg Regional Plan, 2009). Common use resources involves infrastructure and basic services mainly

electricity, water and waste removal which are used by the majority inhabitants and can be used to stimulate investment (City of Johannesburg Regional Plan, 2009).

In order to alleviate the identified dilemmas; the Johannesburg West Region C Council, City Power, Johannesburg Metropolitan Police Department (JMPD), Johannesburg Road Agency (JRA) and Joburg Water (2009) have invested in the following initiatives listed in Table 2.4 with action plans.

Issues	Responsible Department	Action Plan	Budget
*Weak stakeholder relationship among the inhabitant, government and businesses	Johannesburg West Region C Council	* Public education campaigns in line with the Urban Development Framework will be conducted to ensure sustainability of urban management interventions and public participation; *Stakeholder identification survey will be conducted to enable the region to establish a communication platform with stakeholders	No Budget Implications
*Poor response time by law enforcement regarding criminal activities, *Informal trading, illegal dumping and illegal connections (Water and electricity)	JMPD	*To establish mobile police Stations; *To form a Community Participation Forum (CPF) and a neighbourhood watch; *Collaborate with the Johannesburg Development Agency (JDA) regarding the eradication of informal trading	Part of JMPD Operating budget
*Lack of light infrastructure for roads and drains; *Outdated transformers, insufficient lights in low-income housing and lack of electric connections	City Power	*To establish light infrastructure for roads and drains; *Upgrade transformer, electrify low-income housing and establish electric connections	R 73 100 000
*Lack of road infrastructure and road signalling; *Insufficient water control	JRA	*Establish road infrastructure including road tarring and road widening *Construction and/or replacement of storm water drainage and water control measures	R 16 100 000
*Outdated water reservoirs *Insufficient water waste piping and systems	Joburg water	*Upgrade outdated reservoirs *Extension of water waste management piping and systems	R 169 769 000

Table 2.4: Initiatives to Minimise Social Dilemmas in Johannesburg West Region C

Source: City of Johannesburg Regional Plan (2009)

The above intervention by City of Johannesburg Regional Plan (2009), indicates that the local government is committed to an action plans in order to alleviate social dilemmas in Johannesburg West Region C and it is further committed to support interventions financially. Therefore, this means that it is up to the inhabitants and business owners of the region to maintain and support these initiatives.

From a business investment view, the future of economic growth lies in the availability and nurturing of social investment (Morel, Palier and Palme, 2009). Therefore it is imperative that the stakeholders concerned take an active approach regarding their involvement in this region. As identified in the study the local government has established social investment frameworks through the provision of infrastructure and services.

To follow, the study explores other investments that may impact or enhance the development of super regional shopping centres in study area, Johannesburg West Region C.

Other Investments

Other investments in relation to the study are defined as business developments or ventures that can be a threat or enhance a development (Anderson and McChesney, 2003). The study identified competitive, alternative and complementary investments as other investments that may impact the economic sustainability of super regional shopping centres, on study area Johannesburg West Region C.

Competing Investments

Competing Investments: In the study context, are investments that are a threat to the profitability of an investment (William, Forgang, and Einol. 2007).

Johannesburg West Region C is enriched with economic nodes that are strategically located around major routes and intersections which include Constantia, Strubensvalley, Princess, Westgate, Roodepoort and Northgate (City of Johannesburg, 2010). In addition, the region has accessibility to the national highway N1 motorway through 14th Avenue and Gordon Road and; major arterials including Beyers Naude, Main Reef Road, Randfontein Road, Ontdekkers Road and Malibongwe Drive. These locations make Johannesburg West Region C a catalyst for retail development. The region is also characterised with large open spaces, dams, lakes and ridges which indicates that there is spatial and location potential for another super regional shopping

centre (City of Johannesburg, 2010). Due to these economic prospective; the region has atleast three competitive shopping centres namely Cradlestone Mall, Westgate Regional Shopping Centre and Clearwater Mall (Mall Guide, 2014).

However, the study region is also characterised by entrenched poverty as one of the main issues in township areas such as Leratong, Itsoseng, Motolesville, Bram Fischerville, Doornkop, Thulani, Zandspruit and Tsepisong (City of Johannesburg, 2010). A township area in South African context refers to urban residential areas (often underdeveloped) built around the city's outskirts in which the non-white inhabitants used to live during the Apartheid era (mostly black and Indian and coloured; working class communities) which forms part of the backlogs of present South Africa (Lundahl and Sodergren, 2008). Township communities often have small retailers called "Spazas" or "Tuck shops" which hold a significant market share relative to shopping centres due to retailers:

- Allowing easy availability of credit (retailers often apply the Human Trust Policy),
- Providing emergency needs within easy accessibility of consumers (such as food and toiletries)
- Selling in smaller quantities per unit relative to shopping centres

(Ligthelm, 2008)

This information projects that it could be a challenge for shopping centre investors to retain customer dependability in these areas.

The study further established that existing super regional shopping centres and small retailers can be competitively challenging. However, the ability to capture and maintain customer loyalty has become a challenge to super shopping centre investors as alternative investments can create barriers to profit opportunities.

Alternative Investments

Alternative investments are classified as any investments outside the three traditional asset types been stocks, bonds and cash (Abraham, 2006). The term refers to investment assets such as art, antiques, precious metals, sports cards and even time spent at places of entertainment such a museums, fares or casino's (Thune, 2013).

The definition for alternative investments implies that we cannot ignore that there are other activities that consumers would like to take part in besides shopping in super regional shopping

centres. Johannesburg West Region C has many attractive areas such as top rated guests houses, 10 recreation centres and 12 public libraries (City of Johannesburg, 2012). In addition, this region is listed by SA Venues (2013) as one of the “Must See” regions in Gauteng by tourists boasting the beautiful Walter Sisulu National Botanical Garden, Cradle of Human Kind and the infamous holiday destination Magaliesburg. These activities convey the realisation that we should take note that consumers can participate in other activities and that the identified activities have an effects on income derivative of super regional shopping centres in study area Johannesburg West region C.

However, at times it may be wise to embrace alternative investments instead of viewing them as an investment hurdle.

Complementary Investments

Complementary investments in the context of the study are created by the correspondence of parties through consumers with a view of making profit or mutually beneficial encounters (O'Connor, 1979).

Fouche and Wilkinson (2012), state that the future of retailing in South Africa lies in investors' aligning their goods and services to complementary activities. As indicated in the study, Johannesburg West Region C has activities such as recreation centres, libraries and tourist attractions (City of Johannesburg, 2012). Investor of super regional centres in the study area can align their goods and services to the mentioned complementary activities by engaging with investors that own the activities and consumers that use the facilities with the aim of making profit or mutually beneficial encounters.

Special Uses

Special uses can be described as a right granted by local zoning authority to conduct certain activities within a zoning district (Friedman, Harris and Diskin, 2005). Johannesburg West Region C includes the Witwatersrand Basin which encompasses the Crown Mines (Viljeon, 2009). At present the mines are dormant however, in future mining investors are interested in mining sedimentary minerals as a result of previous gold mining (Grove and Harris, 2010). The Crown Mines has a significant impact to the study area as it stretches 350 kilometres to the east and west of Johannesburg, as depicted in figure 2.4.

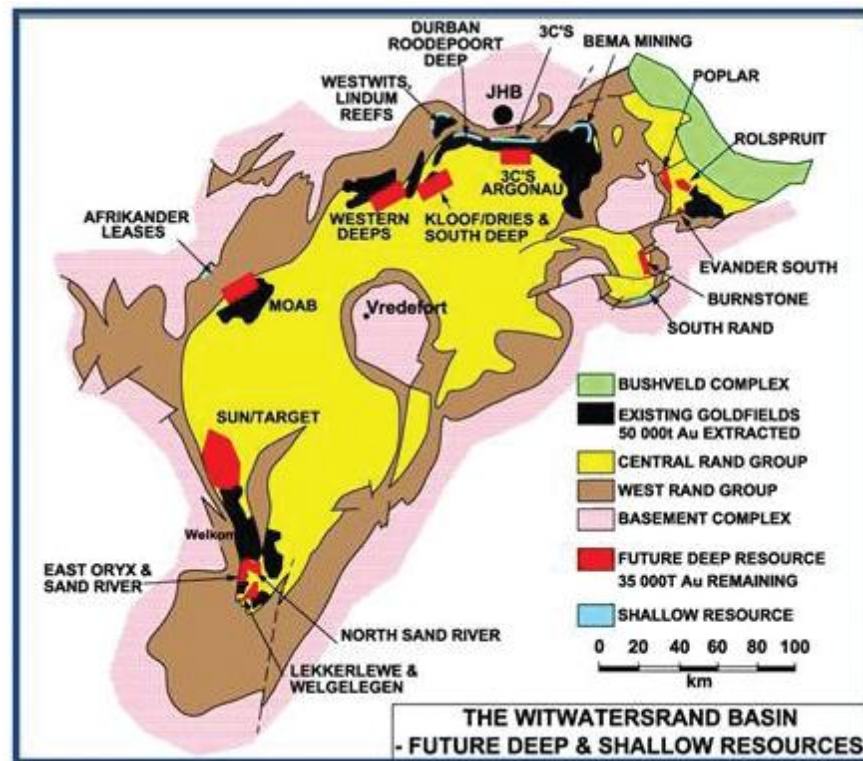


Figure 2.4: Special Use ⇒ Witwatersrand Basin

Source: Viljeon (2009)

The Crown Mines are protected by the Mineral and Petroleum Resources Act of 2002 (Bakheit, 2005). Some of the major land arteries are currently sheltered and/or unavailable for development due to the mining rights (Bakheit, 2005).

Investor view the mining belt as a hindrance for economic growth and further development because the mining belt extends to the main economic nodes in the area; and current investors suffer from economic decline consequent to the Crown Mines shutting down after the gold rush (Johannesburg Development Agency, 2005).

However, in recent years the local government viewed the mining as a window of opportunities for investors. The Department of Development Planning and Facilitation, (2004) initiated and implemented the East West Development Corridor (EWDC). The vision of the EWDC is to develop an effective and sustainable business spine through the optimal utilisation of economic

activities, land uses, and institutional arrangements; in order to achieve commercial networking, development opportunities and optimum spatial assimilation (Integrated Transport Plan, 2004).

The main goals of the visions are identified as follows:

- Goal 1: Create an efficient transport system, including the following elements:
 - To provide an effective mass public transport system;
 - Effective and high-quality road infrastructure (including systems of mobility and activity spines);
 - Intermodal facilities at key strategic activity centres;
 - Provide a choice in the transport modes that can be used;
 - Improve services and infrastructure that will build opportunities to create a metropolitan and provincial logistics and distribution hub (i.e. City Deep);
 - Improved access to work, home and recreational areas of local communities in a safe and secure environment.
- Goal 2: Create an efficient urban structure;
- Goal 3: Encourage integrated and liveable neighbourhoods; and
- Goal 4: Economic regeneration.

(Integrated Transport Plan, 2004)

Although in theory these initiatives seem like they will be the magnet of investment to investor's of super regional shopping centres, in practice they may be a challenge as the area has a legacy of disinvestment.

To follow, the study investigates the interest of consumers towards super regional shopping centres by exploring demand macroeconomic factors.

Furthermore, the study also identifies and explore whether factors of demand in the macroeconomic environment can affect the redevelopment of a super regional shopping centres in study area Johannesburg West Region C.

2.3 Factors that affect Demand

The purpose of figure 2.3 is to identify and explore factors that affect demand on a macroeconomic level.

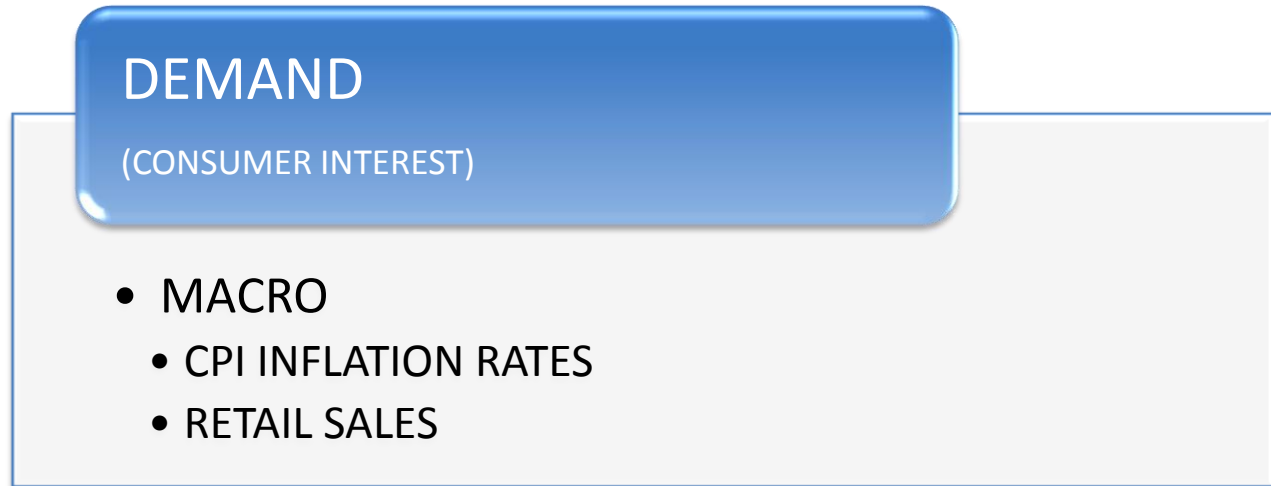


Figure 2.5: Demand Economy Environmental Analysis

Source: Author (2013)

Figure 2.5 represents the building blocks of demand (representing consumer interest) which are CPI inflation rate and retail sales on a macroeconomic level of analysis. The study explores how these factors relate to vacancy rates of super regional shopping in South Africa.

2.4 Demand and the Macroeconomic Environment

Demand in this context is defined as the interest that a consumer displays towards a current or future development or redevelopment through the amount of money they are willing and able to spend at a specific time period (Wilkinson and Reed, 2010).

The study only analysis demand on a macroeconomic level due to the fact that results from observing the human population are more firm and predictable in a large population (Joas and Klein, 2010). Therefore, this means that the larger the population sample representing consumers, the more reliable the results.

In the retail economy consumer patterns are reflected by Consumer Price Index CPI inflation rates and retail sales (YoY) which can be examined as follows.

2.4.1 Macroeconomic Analysis: CPI Inflation Rate and Retail Sales (YoY)

Retail profits in the South Africa have remained resilient, despite the harsh economic environment. As a result, the South African retail industry is the largest in the sub-Saharan region and is positioned as the 20th largest retail market in the world (Thomas White International Ltd, 2011).

Despite the rising CPI inflation rates (Stats SA, 2014), South African consumers take pleasure in shopping and this is reflected in the country's increasingly prosperous shopping centres which grew an average of 3% in the years 2004 – 2012 (Economic Analysis Unit of SRM, 2012) and achieving year on year retail sales averaging 5.31% between the years 2004 – 2013 (Trading Economics, 2014). Although, vacancy rates remain a concern in the South African retail sector, super regional shopping centres averaged a stable vacancy rate of 2.25% between the years 2007 – 2012 (Investment Property Databank Limited, 2013).

Vacancy rate is the calculated percentage square footage of all available rental area in a property that is vacant or unoccupied at a particular time (Falzon, 2013). In retail terms a high vacancy rate usually indicates that there is an oversupply of rentable area where as a low vacancy rate indicates that rentable units are fully occupied or there is a high demand for a particular shop or use (Goddard and Marcum, 2012). In the demand macro economy, vacancy rates are normally influenced by the inflation rates and retail sales (Svets, 2010).

This section of the study uses scatter chart analysis labeled figure 2.6 and 2.7, inferential and descriptive statistics to analyze macroeconomic variable; CPI inflation rates and retail sales in relation to vacancy rates of super regional shopping centres in South Africa. The reason why the study uses vacancy rates as a measure of CPI inflation rates and retail sales is because vacancy rates are sensitive to consumer behaviour, which is represented through to CPI inflation rates and retail sales (Burayidi, 2013). Furthermore, vacancy rate are one of the important indicators that reveal the success of a redevelopment (Pindus, Wial, Wolman, 2009).

CPI Inflation Rate

Consumer Price Inflation (CPI) Inflation rates can be defined as a measure that observes the weighted average prices of a basket by purchaser's goods and services, such as food and clothes (Lydon, 2009).

In the demand macroeconomic analysis, there seems to be a relationship between changes in CPI inflation rates and changes in vacancy rates. On a year lag analysis of the relationship, using CPI inflation rates and vacancy rates super regional shopping centres statistics from 2003 – 2012, on average when the CPI inflation rate increases by 5% vacancy rates of super regional shopping centres decrease by at least 3%; and when the CPI inflation rate decreases by 5% vacancy rates of super regional shopping centres increase by atleast 3% on a yearly basis in South Africa (Inflation.eu, 2013 and Investment Property Databank Ltd, 2013). In addition, South Africa experienced the highest inflation rate of 20.90% in 1986 (Trading Economic,2013), however during that period (1985 – 1989) the country also experienced its first significant increase in shopping centre development by developers and investors due to the potential economic benefits of shopping centre developments (Economic Analysis Unit of SRM, 2012). This observation leads the study to investigate whether there is a relationship between inflation rates and the redevelopment of super regional shopping centres in South Africa and; whether the resultant relationship is significant for the redevelopment of super regional shopping centres in South Africa.

In order to establish the relationship between CPI inflation rates and the redevelopment of super regional shopping centres in South Africa, changes in CPI inflation rates and changes in vacancy rates of super regional shopping centres in South Africa is analysed utilizing a figure 2.6 and the bivariate correlation coefficient analysis. The relationship analysis involves the assessment of changes in CPI inflation rates and changes in vacancy rates of super regional shopping centres from the years 2003 to 2012 in South Africa on a year lag.

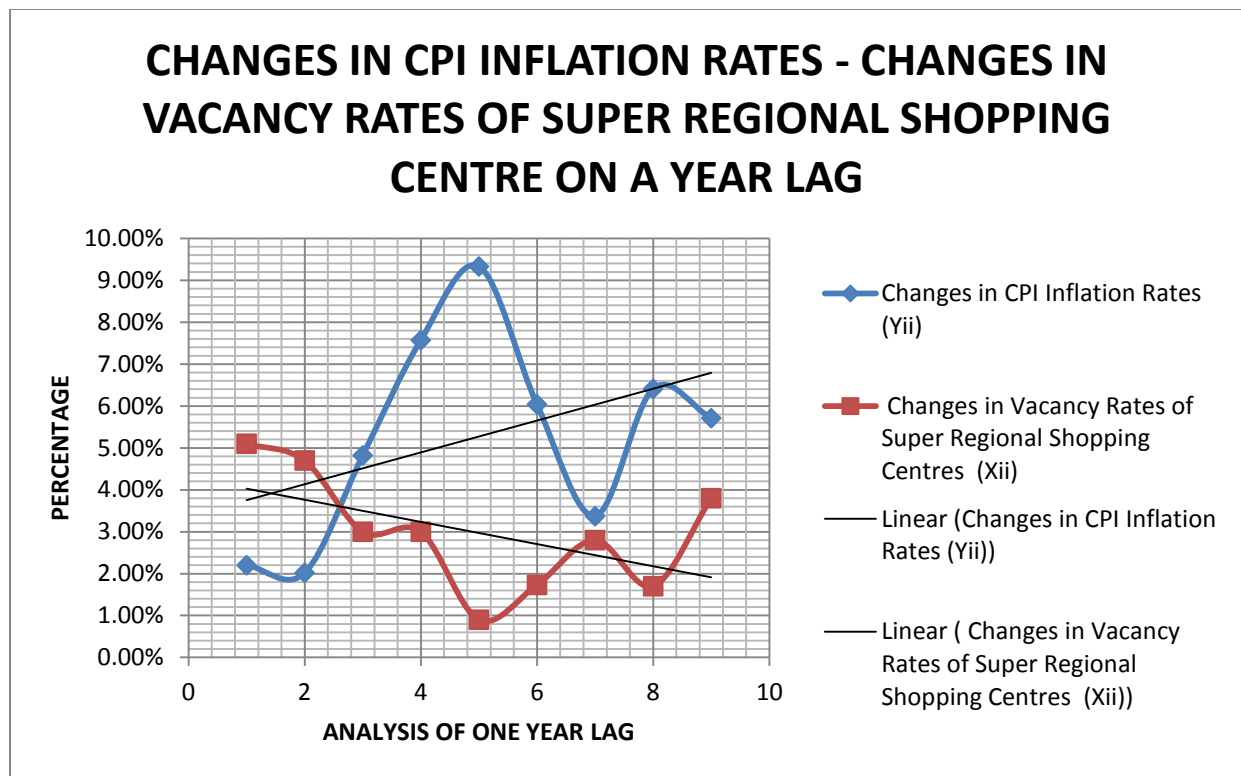


Figure 2.6: Changes in CPI Inflation Rates and Changes in Vacancy Rates of Super Regional Shopping Centres on a Year Lag

Source: Investment Property Databank Ltd (2013), Inflation.eu, (2013) and Appendix B (2014)

Figure 2.6 represents the relationship between changes in CPI inflation Rates and changes in vacancy rates of super regional shopping centre, on a year lag. The figure reveals that changes in CPI inflation rates have a moderate impact on changes in vacancy rates due to the fact that both variables have similar value changes. Furthermore, on analyses of the linear lines, the variables move in opposite direction meaning that when changes in CPI inflation rates increase, changes in vacancy rates of super regional shopping centres decrease and; when changes in CPI inflation rates decrease, changes in vacancy rates of super regional shopping centres increase for the same period on a year lag.

This relationship is confirmed by the correlation coefficient value of -0.618 (Appendix C). The value further reveals that the relationship is moderate due to the fact that the correlation lies within the -0.3 and -0.7 negative relationship interval (Ratner, 2004). The moderate relationship

means that there is a possibility that there is no relationship between changes in retail sales and changes in vacancy rates of super regional shopping centres in South Africa.

Retail sales are key indicators of consumer spending (Frumkin, 2006), hence the study further identified retail sales as one of the important factors affecting consumer demand. The study explores the importance of retail sales on a macroeconomic environment as an indicator of consumer demand.

Retail Sales (YoY)

Retail sales are defined as the selling of goods and services to the final consumer for consumption (Panda, 2009).

Statistics South Africa (2013) reported retail sales reaching an all time high of 15.3% in 2009, on a year on year analysis. Coincidentally, a year later vacancy rates of super regional shopping centres in South Africa were recorded at one of its all time lowest of 0.9% in 2010 (Investment Property Databank Ltd, 2013). This relationship analysis indicates that there could be a negative relationship between changes in retail sales and changes in vacancy rates of super regional shopping centres in South Africa. Furthermore, (Pindus, Wial, and Wolman, 2009) state that an increase in retail sales and a decrease in vacancy rate is an indication of profitability in retail sector and therefore forms a firm relationship amongst the variables.

In order to observe and statistically analyse the relationship between changes in retail sales and changes in vacancy rates of super regional shopping centres in South Africa. The study utilized Figure: 2.7 to observe the variables relationship, and the correlation coefficient measure in order to statistically analyse the relationship.

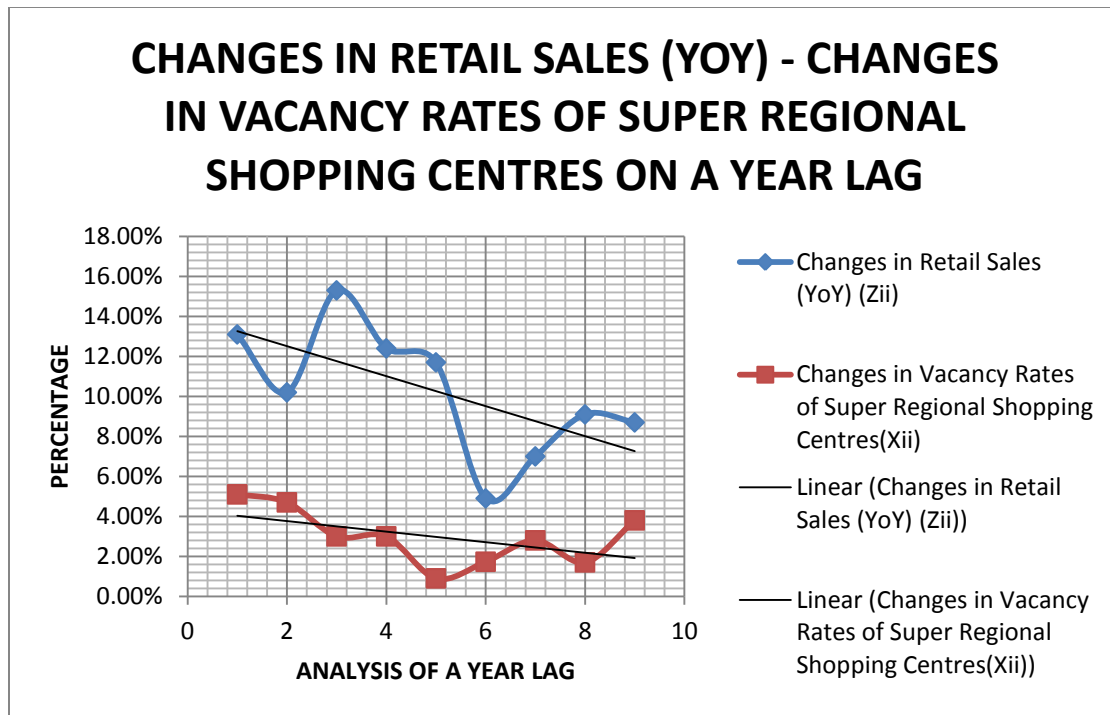


Figure 2.7: Changes in Retail Sales (YoY) and changes in Vacancy Rates of Super Regional Shopping Centres on a Year Lag

Source: Investment Property Databank Ltd (2013), Stat SA (2013) and Appendix B (2014)

Figure 2.7 represents the relationship between changes in retail sales (YoY) and changes in vacancy rates of super regional shopping centre, on a one year lag. The figure reveals that large values of changes in retail sales (YoY) have a low impact on changes in vacancy rates of super regional shopping centre, which is represented by the lower values of changes in vacancy rates of super regional shopping centre in relation to changes in retail sales (YoY) values. On analyses of the linear lines, the variables move in the same direction meaning that when changes in retail sales increase, changes in vacancy rates of super regional shopping centres increase and; when changes in retail sales decrease, changes in vacancy rates of super regional shopping centres decrease for the period on a one year lag.

However, when calculating the correlation coefficient value, the variables yielded a result of - 0.259 (Appendix C). This means that when changes in retail sales increase, changes in vacancy rates of super regional shopping centres decrease and; when changes in retail sales decrease,

changes in vacancy rates of super regional shopping centres increase for the period on a one year lag. Due to the reason that the linear lines on Figure 2.7 and the correlation coefficient method yield different results, the study utilizes and analyses the correlation coefficient value due to the fact that the correlation coefficient method of analysis is more accurate than the linear lines analysis of the variables (Mitchell and Jolley, 2012)

The correlated value of -0.259 reveals that there is a weak relationship between the variables which lies within the 0 and -0.3 negative relationship interval (Ratner, 2004). The weak relationship means that there is a possibility that there is no relationship between changes in retail sales and changes in vacancy rates of super regional shopping centres in South Africa.

Demand Macro Economy Multivariate Anova Analysis

In the demand macroeconomic analysis, it is statistically evident that there is a negative relationship between both variables; changes in CPI inflation rates and changes in retail sales in relation to changes in vacancy rates of super regional shopping centre on a one year lag. The study further established that there is a probability that there is no relationship between changes in CPI inflation rates and changes in retail sales in relation changes in vacancy rates of super regional shopping centre on a one year lag in South Africa.

In order to test whether or not there is a probability that there is no relationship between changes in CPI inflation rates and changes in retail sales in relation to changes in vacancy rates of super regional shopping centre in South Africa. The study utilizes the null hypothesis testing which is expressed as follows:

$$H_0: \mu_1 = \mu_2$$

where:

H_0 Is the null hypothesis that states that there is no relationship between changes in CPI inflation rates and changes in retail sales in relation to changes in vacancy rates of super regional shopping centres in South Africa.

μ_1 Changes in CPI inflation rates

μ_2 Changes in retail sales

From the above null hypothesis test equation; changes in CPI inflation rates and changes in vacancy rates are independent variables which are equal in the equation due to the negative correlation they share in relation to changes in capital values of super regional shopping centres on a year lag. Therefore, the dependent variable is the changes in vacancy rates of super regional shopping centres.

The two-way multivariate anova analysis was used to test whether or not there is a relationship among macroeconomic factors; changes in CPI inflation rates and changes in retail sales in relation to changes in vacancy rates of super regional shopping centre on a one year lag. Within the multivariate analysis, the one-tail test was used to examine the variables due to the fact that it can determine whether or not the null hypothesis should be rejected (Abell, Braselton and Rafter, 1999).

The study used an f-value of 0.05 to test the hypothesis because it is the accepted research standard for 3 variable analysis (Lavrakas citing Noymer, 2008)

Table 2.5 illustrates how these measurable relate to the resultant hypothesis:

MULTIVARIATE ANOVA ANALYSIS				
Null Hypothesis Testing	Numerator Degree of Freedom	Denominator Degree of Freedom	Required F-Value to Reject Null Hypothesis	Resultant F-Value
Relationship Between Variables	(3 - 1) = 2	(9 - 1) = 8	f < 4.46	0.09
Result: Reject the Null Hypothesis because $f < 4.46$				

Table 2.5: Demand Macro Economic Variables Analysis

Source: Author (2013)

The results yielded a f-value of 0.09 (Appendix D), which means that the test rejects the null hypothesis H_0 that suggests that there is no relationship among macroeconomic factors; changes

in CPI inflation rates and changes in retail sales in relation to changes in vacancy rates of super regional shopping centre on a one year lag. This is due to the fact that the resultant f-value of 0.09, is below the f-value of 4.46.

It is statistically evident that though the relationship between supply macroeconomic factors; changes in CPI inflation rates in relation to changes in vacancy rates of super regional shopping centres South Africa is moderate while the relationship between changes in retail sales in relation to changes in vacancy rates of super regional shopping centres is weak, there is a 95% probability that there is a relationship between the variables. This means the relationship between supply macroeconomic factors; changes in CPI inflation rates and changes in retail sales in relation to changes in vacancy rates of super regional shopping centres is significant for the redevelopment of super regional shopping centres in South Africa.

2.5 Conclusion

This chapter aimed to analyse the supply and demand economy for the use of multi-stage real options in order time redevelopment of super regional shopping centre in South Africa, with the use of study area Johannesburg West Region C. It is theoretically and statistically evident that all stated levels of economic analysis; macro, meso and micro are significant for the redevelopment of super regional shopping centres in South Africa, when applied in the appropriate context. In addition, with the use of study area Johannesburg West Region C, the study further established that the economic feasibility and sustainability of any retail development is realised through a thorough economic analysis of the environment.

Chapter 4 elaborates on the financial analysis of real options in order to understand and investigate how real options can be applied in practice, utilizing Chapter 1 changes in demand and supply economic analysis.

To follow, Chapter 3 explores and tests the research methodology applied in the study.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction to Research Methodology

Research is a science that bridges the gap between theoretical and practical problems to find an operator-able solution.

(Author, 2013)

The author implies that research is a discipline that is not restricted to any problem, as problems form part of a workable solution.

However, in order to achieve a workable solution the research methodology relating to the study has to be applied. Research methodology aims to explore what, how, where and why the information utilised in the study was collected (Ethridge, 2004) by interpreting and verifying the data collected.

3.1 Application of Research Methodology

The study's research methodology details the logic and systematic approach in which useful and new information was compiled on the appropriate profit maximizing timing strategy for redevelop super regional shopping centres in South Africa through multi-stage real options which take into consideration changes in supply and demand, on study area Johannesburg West Region C.

Due to the fact that the research is an empirical study that relies on quantitative information, the research methodology examines content and statistical analysis then tests the information through reliability measures in order to ensure that the research is valid. Furthermore, secondary data collected from internal and external sources were analysed (Ali, 2012).

To follow, this section investigates empirical research evidence relating to the study.

3.2 Empirical Study Evidence

Verifies whether the quantified information is reliable or (if applicable) valid through analysis of measured variables (Hartas, 2010). The research utilised Figure 3.1 and section 3.2.1 to illustrate and investigate the empirical research evidence in the study.

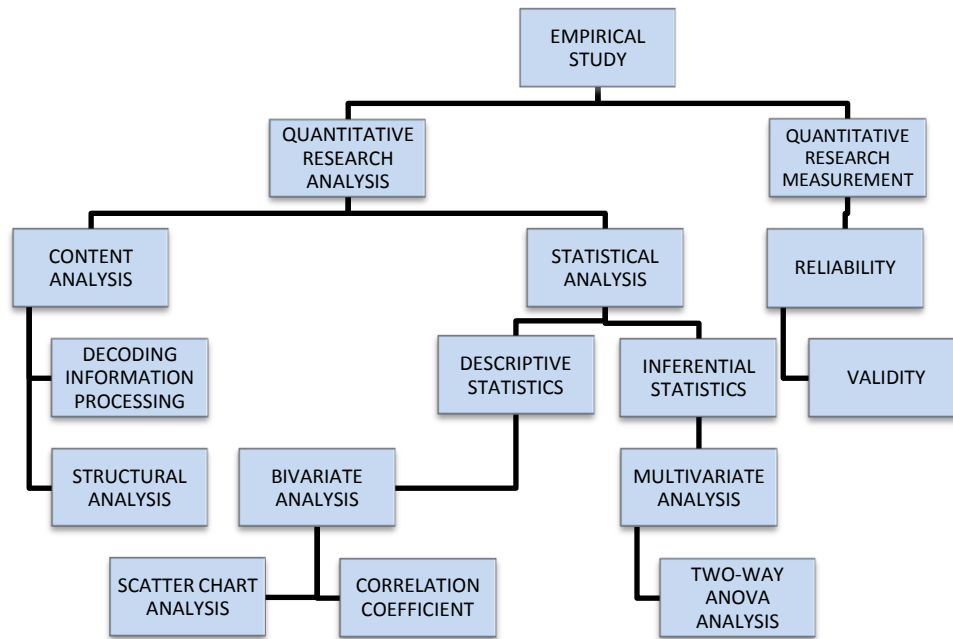


Figure 3.1: Analysis of Quantitative Research Data and Measurement

Source: Author (2014)

The study explains and examine figure 3.1 as follows:

3.2.1 Application of Empirical Study Evidence

As identified, the research is an empirical study (Moody, 2002) in the view of the fact that the study utilizes secondary data to answer the research question:

Would the use of multi-stage real options determine the appropriate time for redeveloping super regional shopping centres in South Africa in order to maximise profits, utilising study area Johannesburg West Region C?”

Within empirical evidence, the studies then investigated a quantitative research analysis for assessing content and statistical information.

3.2.2 Quantitative Research Analysis

Quantitative research analysis in this study is utilized to measure various statistical data, views and opinions in a chosen sample and; to quantify data and generalize results from a sample to the population of interest (Kees, 2006).

The study used both content and statistical analysis for the application of multi-stage real options which can be explored as follows:

Content Analysis

Content analysis is described as the scientific study of information with reference to meanings, contexts and intentions contained in the communication (Prasad, 2008). Generally the study utilized the analysis of content in every section. However, this form of analysis was extensively applied in the background of the study, brief literature review and; the supply meso and micro economic analysis.

Within this form of research analysis the study used decoding of information processing and structural analysis which is explained as follows:

Decoding Information Processing

Analyzes whether the information is comprehensible and applicable to the study (Mckeown and Kucan, 2010). This form of analysis is achieved by ensuring that the study is in line with the aim and objectives of the research as illustrated and explained in Figure 1.1, Figure 2.1 and Figure 2.3.

Structural Analysis

Examine whether information has been composed in a logical and explicable sequence (Czarniawska. 2004). This form of analysis is conducted by ensuring that information in the study is understandable, coherent and corresponds to Figure 1.1, Figure 2.1 and Figure 2.3.

The research delves into statistical analysis of the study which involves both descriptive and inferential statistics.

Statistical Analysis

In the study, statistics were used to calculate, interpret and present data. The statistical analysis of the study utilized:

Descriptive Statistics, Bivariate Analysis $\Rightarrow$ Scatter Chart and Correlation Coefficient

Descriptive statistics were used to summarise a data set and to numerically describe a measured sample (McNabb, 2002). The study utilised the bivariate analysis which involves the analysis of two variables through the scatter chart analysis (Cram and Friedrichsen, 2012) and the correlation coefficient method (Bennett, 1986). The scatter charts in the form of Figure 2.2, 2.3, 2.6 and 2.6, analysed the relationship between two variables by visually observing the association of variables (DeFusco, McLeavey and Pinto, 2011); and the correlation coefficient method measured the degree to which two variables movements are associated (Beri, 2010). The scatter chart analysis and the correlation coefficient statistical calculation was utilised in the supply macro economy to measure changes in GDP growth rates and changes in prime interest rates; in relation to changes in capital values super regional shopping centres; and in the demand macro economy to measure changes in CPI inflation rates and changes in retail sales (YoY); in relation to changes in vacancy rates values super regional shopping centres on a year lag (Appendix B).

Inferential Statistics, Multivariate Analysis $\Rightarrow$ Two-way Anova Analysis

The study utilized inferential statistics (Geisler, 2004) to draw conclusions and apply calculated predictions about the measured populations in the supply and demand macro economy. In both macro economies, the study statistically proved that the measured populations are significant for the redevelopment of super regional shopping centres in South Africa through the multivariate analysis. The multivariate analysis observes at least two statistical outcome variables at a time to produce a final outcome (Dewberry, 2004). The multivariate analysis was applied utilising the two-way anova (Allen, 2004) analysis which tested the influence of two independent variables on one dependent variable in the supply and demand marco economy respectively (Appendix D).

In the section to follow, the study explores quantitative research measurements applicable to the researched information.

3.2.3 Quantitative Research Measurements

Quantitative research measurement: Evaluates the reliability of the data, in order to claim validity of findings (Flick, 2011). The research defined and assessed reliability in relation to the study as follows.

Reliability

Reliability is concerned with whether the research analysis produced consistent results (Payne, 1999). The study utilizes inter-coder reliability and test – retest reliability measures, which were applied as follows:

Inter-coder reliability: Was utilised to examine content analysis which examines the state in which different analysts or indicators allocate the same results to the same categories (Chelimsky, 1989). This form of analysis was utilised in Chapter 1 background of the study in which Stats SA (2013) and Trading Economists (2006) analysts concur that the retail industry is profitable through retail statistics and; in the problem statement in which capital values and vacancy rates of super regional shopping centres in South Africa statistics concur that there is a

decline in profitability of super regional shopping centres between the years (2007 – 2012) despite redevelopment. Furthermore, (Abina, Comlin, Nadeau, Smetane, 2008) are of the opinion that real options present an approach that allows for flexibility with regards to the timing of redevelopment. In Chapter 2, Shaw's (2011) definition of meso economic level of analysis and Agard's (2010) definition of local authority both concur that the City of Johannesburg (2010) is the body that exercises power and authority over Johannesburg West Region C. In the micro level of analysis the City of Johannesburg (2010) and the councillor of Johannesburg West Region C Willie van der Schyf (2013) view urban decay is a major social risk in the region; and Anderson and McChesney (2003) concur on the same definition for other investments. Regarding the Witwatersrand Basin as a special use; Viljeon, (2009) and Bakheit (2005) agree that the Crown Mines occupy a significant area in Johannesburg West Region C.

Test – retest Reliability: Is concerned with assessing the consistency of results over a period of time (Jackson, 2011). Utilising descriptive and inferential statistics over a 10 year period (2003 – 2012) the study deduced that supply and demand macro economic factors are significant for the redevelopment of super regional shopping centres in South Africa.

The study was able to prove reliability through inter – code and test - retest reliability. Therefore, this means that the study can claim validity which is analysed as follows.

Validity

Is the accuracy of inferences and conclusions drawn from the study results (Gatewood, Feild, Barrick, 2007). The study explains validity analysis applicable to the study using Table 3.1.

Type of Validity	Definition	Application
Construct	Refers to the extent to which data measures the research's intention (Glynn and Woodside, 2009).	In relation to the research question, the study utilized construct validity by analysing supply on a macro, meso and micro economic level; and demand on a macroeconomic level of analysis.
Content	Is a non-statistical appraisal that involves the methodical assessment of the examined content to measure whether it covers a represented sample (Holosko and Thyer, 2011).	Supply meso economic variables urban decay and transportation; and micro economic variables social risks and other investments were utilized in content validity.
Criteria	Involves establishing a correlation coefficient between the test and a criterion variable (Gliner and Morgan, 2000).	The bivariate correlation coefficient method was used to examine supply and demand macroeconomic variables. In the supply macro economy, test variables GDP growth rates and prime interest rates were examined in relation to criterion variable capital values of super regional shopping centres; and in the demand macro economy, test variables CPI inflation rates and retail sales (YoY) were examined in relation to criterion variable capital values of super regional shopping centres in South Africa.

Table 3.1: Validity Analysis Assessment

It is evident that the study is reliable and the results are valid due to the fact that the study meets the assessment procedures for empirical study evidence in numbering 3.1. However in addition, the study has to verify the data collected.

3.3 Data Collection

“Empirical research is only as good as the data on which it is base, ...”

Punch (2005)

Punch (2005) highlights the importance of data collection in an empirical study as it forms the foundation of the research. Therefore, it is imperative for the study to conduct a thorough data collection analysis in order to ensure that the data collected is credible and it is harvested from reputable databases. The study utilised secondary data information which is illustrated in Figure 3.2 and explained in section 3.3.1 as follows.

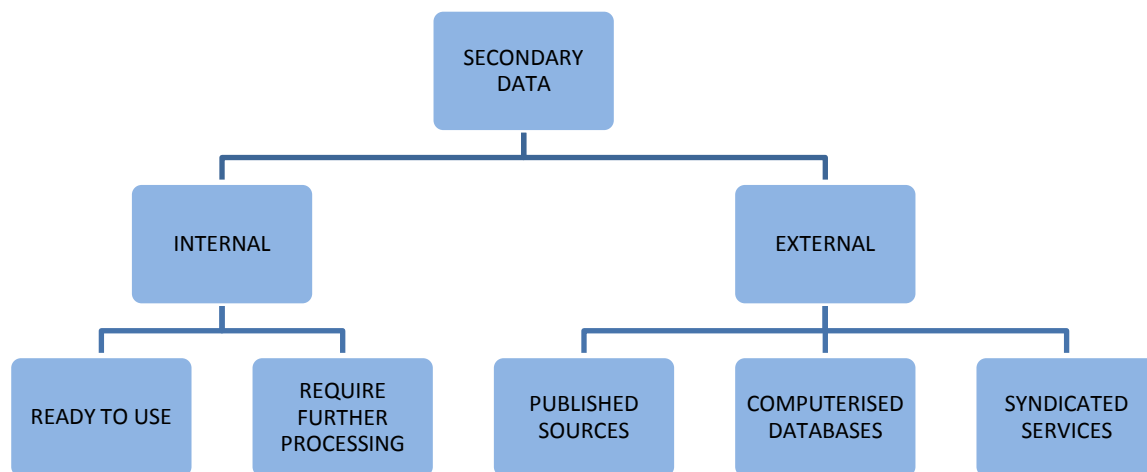


Figure 3.2: Classification of Secondary Data

Source: Zikmund, Ward, Lowe and Winzar (2007)

3.3.1 Secondary Data

Is information that is not collected by the author or specifically collected for the author (Collins, 2010). The study collected internal and external sources of secondary data which are explored as follows:

Internal Sources

For the purpose of the study, internal sources (Stevens, Wren, Sherwood and Ruddick, 2006) refer to data collected for the specific use or reference to the retail property industry, which can be identified as:

Ready to Use: Which is information that does not need analysis, it can be directly applied to the study (D'Amico, 1969). This sort of information was sourced from databases such as; (Cirz, 2012) and Trading Economics (2012).

Require Further Processing: Entails information that needs to be analysed before it is applied to the study (Polonsky and Waller, 2010). This sort of information was sourced from databases such as the Investment Property Databank Ltd (2013) and the Economic Analysis Unit of SRM (2012).

To follow, the study explores external sources.

External Sources

For the purpose of the study, external sources (Beri, 2007) refer to data that is not collected for the specific use or reference to the retail property industry however it is applicable to the study. Table 3.2 explains and applied external sources of information to the study as follows:

Type of Sources	Definition	Application of the Source in the Study
Published Sources	Is information circulated from governmental and general business sources (Choo, 2002)	*City of Johannesburg (2010) *Department of Transport(2013) * SA Venues (2013)
Computerised Databases	Are classified as online, internet and offline information sources (Wiid and Digginess, 2010)	*Liberta (2013) * Guthrie (2009)
Syndicate Services	Are firms that collect information designed to fit the needs of many users (Hiray, 2007).	*Stats SA (2013) *Inflation.eu (2013)

Table 3.2 External Sources Assessment

3.4 Conclusion

The study investigated and met relevant empirical study evidence and data collection analysis procedures. Through empirical study evidence, the research applied pertinent quantitative research analysis and measurement procedures; and examined the data through reliability and validity testing. Through data collection analysis, the study examined the credibility of the data and the reputability of databases through internal and external source data analysis procedures.

To follow, Chapter 4 applies research results, analysis and interpretation by investigating multi-stage real options for the use of redevelopment of super regional shopping centres in South Africa, utilizing study area Johannesburg West Region C.

CHAPTER 4:

RESEARCH RESULTS, ANALYSIS AND INTERPRETATION

4.0 Significance of Research Results, Analysis and Interpretation to the Study

In an increasingly uncertain and dynamic global market place managerial flexibility has become essential for firms to successfully take advantage of favorable future investment opportunities, respond effectively to technological changes or competitive moves, or otherwise limit losses from adverse market developments.

(Trigeorgis, 2002)

The quote by Trigeorgis (2002) implies that future planning and timing of investments opportunities has become essential in current market conditions in order for investors to stay ahead of competition and keep up with technological advancements.

This chapter is significant due to the fact that it explores and statistically examines the financial aspect of multi-stage real options, then applies the concepts in practice with the use of Shopping Centre A as a case study in Johannesburg West Region C.

4.1. Multi-Stage Real Options

In real estate context, multi-stage real options are opportunities that give investors the decision to exercise (develop or redevelop) a property with the advantage of timing future redevelopment and generating profit (Schwartz and Trigeorgis, 2004). Real options have been researched for more than three decades; however a significant breakthrough in real options investment analysis was achieved by Fischer Black and Myron C. Scholes in the early 1970s at the MIT Sloan School of Management with their famous Black-Scholes formula (Schulmerich, 2010). The formula calculates the time in which redevelopment of a property should take place by analysing the worth of the property (which can be determined through the market capitalisation rate (Mogodi, Lesetedi and Mangwale, 2011)), the purchase price of property; if it were to be sold (which can be determined through the exit capitalisation rate (Pirounakis, 2013)), possibility of redeveloping the property, the compensation for systematic risk which cannot be eliminated by

holding a diversified portfolio and the standard evaluation of measured supply and demand economic variables considered for redevelopment (Benninga and Czaczkas, 2000).

The Black-Scholes formula for timing redevelopment can be expressed as follows, in relation to the study:

$$t = \ln(s/k) / d(1 - r^\sigma - s^{2\sigma}/2)$$

Where:

T = Time in which redevelopment should take place expressed as a percentage of a year/s, ie. 1% equals a year to redevelopment.

S = Current capital value of property

K = Current purchase price of property if it were to be sold

d = Probability to redevelop

r = Risk-free interest rate

σ = Standard deviation

In order to comprehend the statistical analysis of real options using the Black-Scholes formula, the study utilizes Shopping Centre A as a case study to understand the significance of real options as an investment analysis on the redevelopment of super regional shopping centres in South Africa, on study area Johannesburg West Region C.

4.2 Case Study: Real Options Financial Analysis on Shopping Centre A

The timing of redevelopment has become essential to shopping centre investor due to consumer interest and the rapid increase in shopping centres in South Africa (Economic Analysis Unit of SRM. 2012). In the last 10 years (2003 – 2012), the capital value of super regional shopping

centres has tripled in South Africa (Investment Property Databank Ltd 2013), meaning that although the retail market is highly competitive it still has lucrative investments opportunities.

In this case study, the Black-Scholes formula is utilized on Shopping Centre A (a non-existent shopping centre) to illustrate how investors can time redevelopment in order to maximise on economic profit and time future redevelopment.

If Shopping Centre A, had a current market value of R1 500 billion and a current exit value of R1 700 billion. Furthermore, the shopping centre projected the same supply and demand macroeconomic statistics as market variables in Johannesburg West Region C which are; the probability to redevelop: $d = p$ value = 0.05 (Chapter 2), risk-free interest rate = 5.50% (Trading economics, 2013) and standard deviation 0.0357 (Appendix C).

Therefore, the appropriate time to redevelop Shopping Centres A, would be:

$$t = \ln(1\,500/1\,700) / 0.05(1 - 0.055^{(0.0357)} - 1500^{2(0.0357)}/2)$$

$$t = (-0.1252)/(-0.0372)$$

$$t = 3.366\%$$

According to the calculation the next redevelopment of Shopping Centre A is statistically approximated as 3 years and 4 months (12×0.366) with the use of timing multi-stage real options for redevelopment.

4.3 Conclusion

The study has proved that the approximate time to redevelop super regional shopping centres in South Africa is possible to determine through the use of timing multi-stage real options. Furthermore, timing multi-stage real options analysis also proved that economic factors; changes in supply and demand can be factored into the financial analysis of timing redevelopment through the Black-Scholes Formula.

Chapter 5 draws conclusions to the study and provide future recommendations based on findings of the results.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview of Research

In Chapter 1, the study aimed to investigate the appropriate profit maximizing timing strategy for redevelop super regional shopping centres in South Africa through multi-stage real options, which takes into consideration economic changes in supply and demand utilising study area, Johannesburg West Region C. Chapter 2 explored economic factors of supply and demand which are pertinent for redeveloping super regional shopping centres in South Africa utilising, study area Johannesburg West Region C. Chapter 3 examined content and statistical data, then tested the information through reliability then validity testing; then further established the credibility and reputability of the collected data. Chapter 4 utilised the supply and demand economic statistical analysis and the Black-Scholes formula for the financial use of multi-stage real options analysis on super regional shopping centres in South Africa. Furthermore, a case study was applied to test multi-stage real options analysis on super regional shopping centres in South Africa utilising the gathered information from research and study area, Johannesburg West Region C.

To follow; the study investigates whether the aim and objectives of the study have been met, and the research question answered.

5.1 Aim and Objectives of the Study

5.1.1 Assessment of the Aim

The aim of the study is to establish the appropriate profit maximizing timing strategy for redevelop super regional shopping centres in South Africa through multi-stage real options, which takes into consideration changes in supply and demand in study area, Johannesburg West Region C.

The study accomplished the aim by investigating the supply economy on a macro, meso and micro level of analysis; and the demand economy on a macro level of analysis utilising study

area Johannesburg West Region C. To analyse the use of multi-stage real option for timing redevelopment in South Africa, the study applied the examined supply and demand economic variables and the Black-Scholes formula on study area Johannesburg West Region C.

5.1.2 Assessment of the Objectives

This section of the study examines whether the study has achieved the set objectives in order to fore fill the aim of the study, which are as follows:

- a) To identify supply and demand economic factors for redevelopment of super regional shopping centres in South Africa, utilizing study area Johannesburg West Region C.*

The study achieved the stated objective by identifying:

- Supply economic variables on a:
 - Macro level of analysis: Focusing on GDP growth rates and prime interest rates in South Africa;
 - Meso level of analysis: Identifying the local government; City of Johannesburg (2010) as the main body of authority in study area Johannesburg West Region C, highlighting main concerns: urban sprawl and transportation in the region;
 - Micro level of analysis: Focused on study area Johannesburg West Region C, analysing the risk of investment by exploring social risks and other investments such as, competing, alternative and complementary investments. In addition the study identified the Witwatersrand Basin as a special use in the region due the significant area it occupies in the region (Viljeon, 2009).
- I. Demand economic variables on a:
 - Macro level of analysis: Examined CPI inflation rates and retail sales (YoY) in South Africa.

- b) *To examine changes in the supply and demand economy for redevelopment of super regional shopping centres in South Africa, utilizing study area Johannesburg West Region C.*

In order to understand changes in supply and demand economy for redevelop super regional shopping centres in South Africa, utilizing study area Johannesburg West Region C. Table 5.1 is used to interpret the result findings of the objective.

CONSIDERATION	RESULTS INTERPRETATION
None	No evidence of measures variable. Evidence must be disregarded.
Weak	Low evidence of measured variable. Evidence can be disregarded.
Moderate	Reasonable presence of measured variable. Evidence can be considered.
Strong	High presence of the measured variable. Evidence must be highly regarded.

Table 5.1: Interpretation of Results for Supply and Demand Economic Analysis

Source: Author (2014)

Taking into consideration Table 5.1, the study yielded the following results as illustrated in Figure 5.1. The explanations of results detail the arrival of the consideration based on the analysis of measured variables.

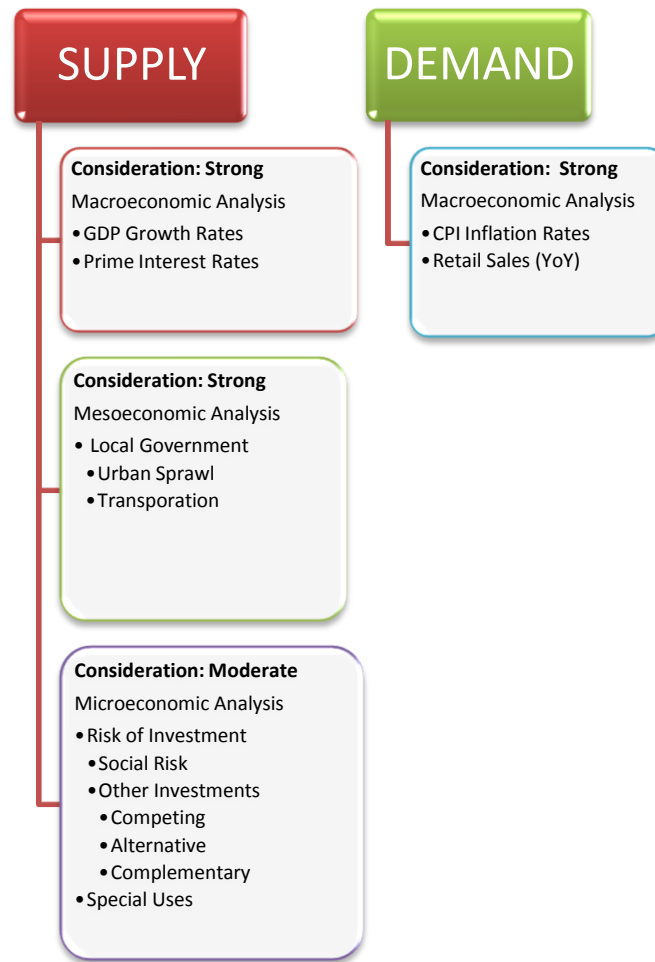


Figure 5.1: Supply and Demand Economic Analysis

Source: Author (2014)

Explanations of Results

In the demand and supply macroeconomic environment, it is theoretically, visually and statistically evident in the study that changes in GDP growth rates, prime interest rates, CPI inflation rates and retail sales (YoY) are important variables to consider; when deciding to redevelop super regional shopping centres in South Africa. Therefore, investors should strongly consider these factors in the decision to redevelop super regional shopping centre as indicated on Figure 5.1.

In the supply meso economic analysis; the local government has a strong influence on the decision to redevelop shopping centres in South Africa on study area Johannesburg West Region C due to the fact that they have power and authority over the regulation of the area (City of Johannesburg, 2010). Furthermore, the local government can be useful in controlling and minimising the region's main problems which are urban sprawl and transportation, through the construction of low-income housing and; the implementation and facilitation of effective transport systems (City of Johannesburg, 2010 and Department of Transport, 2013).

In the microeconomic environment the study identified the risk of investment and special uses as moderate concerns in the study area. Within the risk of investment; social risks and other investments are the main risks concerning the redevelopment of shopping centres in study area Johannesburg West Region C. However, City of Johannesburg Regional Plan (2009) commits to minimise social risks through the effective use and distribution of bulk resources (such as roads, electricity and water). Furthermore, the regional plan focuses on strengthening stakeholder relationships (including the community, Johannesburg West Region C Council, City Power, JRA, JMPD, and Joburg Water). Other investments in the study, are recognized as competing, alternative and complementary investment which can be minimised or be of benefit, depending on the investor's view. The microeconomic environment the study further identified the Witwatersrand Basin as a special use due to the significant area it occupies and mining rights in Johannesburg West Region C (Bakheit, 2005). However, the Development Planning and Facilitation Department (2004) has initiated and implemented the East West Development Corridor (EWDC) to develop an effective and sustainable business spine through optimal utilisation of economic activities, land uses, and institutional arrangements. Therefore, the Witwatersrand Basin may be of weak or no concern in the future.

- c) *Utilising the Black-Scholes Model and examined economic changes in supply and demand, determine the appropriate time for redevelopment super regional shopping centres in South Africa using multi-stage real options in order to maximise on profits, utilising study area Johannesburg West Region C.*

Subsequent to the study examining changes in supply and demand economic factors, the utilized the examined economic variables and the Black-Scholes Formula for the financial

analysis of multi-stage real options. Then the formula was applied to a case study with the use of study area Johannesburg West Region C.

5.2 Research Question

Based on the research problem:

Changes in supply and demand have affected the economic and financial viability of super regional shopping centres. In the last 6 years (2007 – 2012) there have been no additional super regional shopping centres built in South Africa (Investment Property Databank Ltd, 2013). However, despite existing super regional shopping centres under going redevelopment the capital value of super regional shopping centres has decreased from 18.99% to 11.81% and; vacancy rates have increased from 0.9% to 2.6% (Investment Property Databank Ltd, 2013). This analysis means that super regional shopping centre investors in South Africa are faced with a challenge of deciding how to time redevelopment in order to maximise profits.

Multi-stage real options (Chiang, So and Yeung, 2006 and; Guthrie, 2009) give an investor the opportunity to time future redevelopments in order to maximise profits, subsequent to gathering information about changes in supply and demand in the economic environment.

There are methods of determining the approximate value of a property once it has been redeveloped, predominantly the Discounted Cash Flow (DCF) analysis, Net Present Value (NPV) and the Internal Rate of Return (IRR) (Sayce, Smith, Cooper, Venmore-Rowland, 2006). However, these methods of appraisal fail to take into consideration the appropriate time for redevelopment that achieves maximum profitability.

The research question is as follows:

Would the use of multi-stage real options determine the appropriate time for redeveloping super regional shopping centres in South Africa in order to maximise profits, utilising study area Johannesburg West Region C?

The study answered the question by ensuring that the aim and objectives of the study are met. Furthermore, the study contextually and statistically examined solutions in Chapters 2 and 4 by exploring the supply and demand economy; and the Black-Scholes Formula for the financial use

of timing multi-stage real options analysis. While chapter 3 ensured that research results and data utilized were thoroughly investigated and tested through reliability and validity testing; and that the data collected was credible and from reputable databases.

5.3 Contributions and Research Implications

This study contributes to the advancement of real estate research in commercial property economics, investment and finance; and provide property owners the opportunity to strategically time redevelopment in order to maximise profits.

The study is also of benefit to the following stakeholders:

- I. Shopping Centre Investors: To tactfully plan redevelopment,
- II. Property Economists: For an analytical approach to property market research and;
- III. Property Valuers: To determine the value of an income producing property.

5.4 Recommendations for Future Research

In the demand and supply macro economy, the strongest statistically correlated relationship was between changes in CPI inflation rates and changes in vacancy rates of super regional shopping centres in South Africa of -0.618. Furthermore, statistics analysis of Inflation.eu (2013) and Investment Property Databank Ltd (2013) deduce that on average when the CPI inflation rate increases by 5% vacancy rates of super regional shopping centres decrease by at least 3%; and when the CPI inflation rate decreases by 5% vacancy rates of super regional shopping centres increase by at least 3% between the years 2003 and 2012 on a yearly basis in South Africa. During that period, the study also deduced that the inflation rate increases by an average of 5% annually in South Africa (Inflation.eu, 2013).

Therefore, the study recommends a causal research on the impact of CPI inflation rates as a hedge against vacancy rates of super regional shopping centres in South Africa can be investigated.

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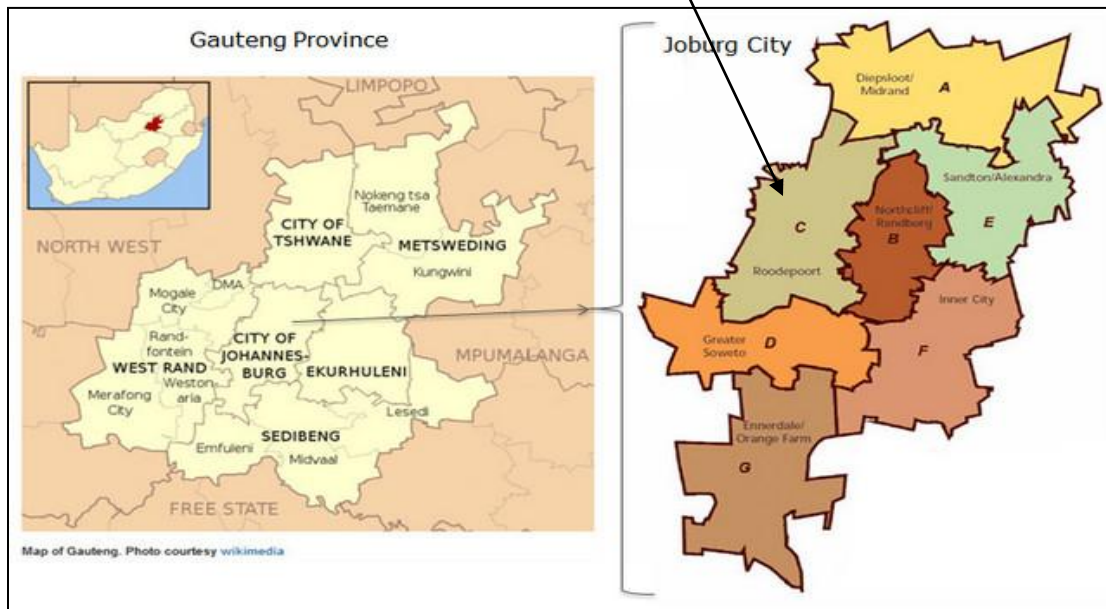
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APPENDICES

APPENDIX A: GEOGRAPHICAL MAP OF THE AREA OF STUDY

JOHANNESBURG WEST REGION C



APPENDIX B: SCATTER CHART ANALYSIS FIGURES 2.2, 2.3, 2.6 AND 2.7

Variables of the Supply Macro Economy

Table 1, are statistics from Investment Property Databank Ltd (2013) (Xi), Liberta (2013) (Yi) and Liberta (Zi) (2013) which is utilized as variable input for scatter chart analysis.

Table 1: Supply Macro Economy Statistics

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Capital Value (Xi)	19.64%	17.64%	27.78%	26.56%	18.99%	5.79%	5.86%	11.59%	3.98%	11.81%
GDP Growth Rates (Yi)	2.80%	6.10%	4.30%	5.90%	6.50%	2.90%	-6.30%	4.00%	4.60%	2.60%
Prime Interest Rates (Zi)	15.50%	11.00%	10.50%	11.00%	13.00%	15.00%	14.00%	10.00%	9.50%	8.50%

Tabulate capital values (Xi) and GDP growth rates (Yi) according to the statistics on Table 1 in Table 2 in order to correlate the relationship changes and lag analysis on Figure 2.2 Changes in GDP Growth Rates and Changes in Capital Values of Super Regional Shopping Centres on a Year Lag.

Table 2: Correlated Supply Relationship Lag

Lag Results	Year (Yi)	Changes in Gross Domestic Product (GDP) Growth Rate (Yi)	Years (Xi)	Changes in Capital Values of Super Regional Shopping Centre (Xi)
lag1	2003	6.10%	2004	17.64%
lag2	2004	4.30%	2005	27.78%
lag3	2005	5.90%	2006	26.56%
lag4	2006	6.50%	2007	18.99%
lag5	2007	2.90%	2008	5.79%
lag6	2008	-6.30%	2009	5.86%
lag7	2009	4.00%	2010	11.59%
lag8	2010	4.60%	2011	3.98%
lag9	2011	2.60%	2012	11.81%

To plot Figure 2.2: Changes in Prime Interest Rate and Changes in Capital Values of Super Regional Shopping Centres on a Year Lag. Use Table 1, capital values (Xi) and Prime Interest Rates (Zi) statistics and plot statistical analysis according to Table 2.

Variables of the Demand Macro Economy

Table 3, are statistics from Investment Property Databank Ltd (2013) (Xii), Statistics South Africa (2013) (Yii), and Inflation.eu (Zii) (2013) which is utilized as variable input for scatter chart analysis.

Table 3: Demand Macro Economy Statistics

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Vacancy Rates (Xii)	5.10%	4.70%	3.00%	3.00%	0.90%	1.73%	2.80%	1.70%	3.80%	2.60%
CPI Inflation Rates (Yii)	-1.63%	2.20%	2.02%	4.82%	7.57%	9.33%	6.04%	3.37%	6.41%	5.71%
Retail Sales (YOY) (Zii)	10.70%	13.10%	10.20%	15.30%	12.40%	11.70%	4.90%	7.00%	9.10%	8.70%

To plot a scatter chart analysis on Figure 2.6: Changes in CPI Inflation Rates in Relation to Changes in Vacancy Rates of Super Regional Shopping Centres on a Year Lag; and Figure 2.7: Changes in Retail Sales (YoY) and changes in Vacancy Rates of Super Regional Shopping Centres on a Year Lag. Follow the same process as the variables of the supply macro economy for Figure 2.2: Changes in GDP Growth Rates and Changes in Capital Values of Super Regional Shopping Centres on a Year Lag. However, instead of using Table 1 statistics use Table 3 statistics as variable inputs.

APPENDIX C: CORRELATION COEFFICIENT

Background of the Study

Capital values and vacancy rates of super regional shopping centres correlation analysis

Table A: Statistics from Investment Property Databank Ltd (2013) (Xi)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Capital Value (Xi)	19.64%	17.64%	27.78%	26.56%	18.99%	5.79%	5.86%	11.59%	3.98%	11.81%
Vacancy Rates (Xii)	5.10%	4.70%	3.00%	3.00%	0.90%	1.73%	2.80%	1.70%	3.80%	2.60%

With the use of Table A statistic, the correlation analysis for capital values and vacancy rates of super regional shopping centres was conducted as follows.

Capital values variance and standard deviation

N = 10

Table B: Population Mean

Year	Capital Values (Xi)	Xi-m
2003	0.20	0.047
2004	0.18	0.027
2005	0.28	0.128
2006	0.27	0.116
2007	0.19	0.040
2008	0.06	-0.092
2009	0.06	-0.091
2010	0.12	-0.034
2011	0.04	-0.110
2012	0.12	-0.032
Total	1.496	0.000

$$\mu = \sum(i=1)^N (Xi)/N$$

$$= [(0.196) + (0.176) + (0.278) + (0.266) + (0.190) + (0.058) + (0.059) + (0.116) + (0.040) + (0.118)] / 10$$

$$= 0.150$$

Table C: Population Variance

Year	Xi-m	(Xi-m) ²
2003	0.047	0.0022
2004	0.027	0.0007
2005	0.128	0.0164
2006	0.116	0.0135
2007	0.040	0.0016
2008	-0.092	0.0084
2009	-0.091	0.0083
2010	-0.034	0.0011
2011	-0.110	0.0121
2012	-0.032	0.0010
Total	0.000	0.065

Population variance for capital values of super regional shopping centres (Xi) as calculated according to Table C and population mean (m) for capital values (Xi)

$$\sigma^2 = \sum (i = 1)^N / [(Xi - \mu)^2] / N$$

$$= [(0.047-(0.150))^2 + (0.027-(0.150))^2 + (0.128-(0.150))^2 + (0.116-(0.150))^2 + (0.040-(0.150))^2 + (-0.092-(0.150))^2 + (-0.091-(0.150))^2 + (-0.034-(0.150))^2 + (-0.110-(0.150))^2 + (-0.032-(0.150))^2] / 10$$

$$= 0.0073$$

Population standard deviation for vacancy rates of super regional shopping centres (Xii) is calculated according to the same process as calculating capital values of super regional shopping centres (Xi) with the use of Table A statistics

Population variance for vacancy rates (Xii)

$$\sigma^2 = \sum(i = 1)^N [(Xii - \mu)]/N$$

$$= 0.0002$$

Population standard deviation for vacancy rates (Xii)

$$\sigma = \sqrt{\sigma^2}$$

$$= 0.0133$$

Table D: Population Covariance

Year	Xi-m	Xii-m	Year Results	(Xi-Xim)(Xii-Xiim)
2003	0.0467	0.0217	Year 1	0.0010
2004	0.0268	0.0177	Year 2	0.0005
2005	0.1281	0.0007	Year 3	0.0001
2006	0.1160	0.0007	Year 4	0.0001
2007	0.0403	-0.0203	Year 5	-0.0008
2008	-0.0917	-0.0120	Year 6	0.0011
2009	-0.0910	-0.0013	Year 7	0.0001
2010	-0.0338	-0.0123	Year 8	0.0004
2011	-0.1099	0.0087	Year 9	-0.0010
2012	-0.0315	-0.0033	Year 10	0.0001
Total	0.0000	0.0000		0.0016

Population covariance for GDP growth rates and capital values of super regional shopping centres as illustrated on Table 8

$$\sigma_{xixii} = \sum(i = 1)^N [(X(i) - \mu_{xi})(X(ii) - \mu_{xii})]/N$$

$$\begin{aligned}
&= [(0.0467)*(0.0217) + (0.0268)*(0.0177) + (0.1281)*(0.0007) + (0.1160)*(0.0007) \\
&\quad + (0.0403)*(-0.0203) + (-0.0917)*(-0.0120) + (-0.0910)*(-0.0013) + (-0.0388)*(- \\
&\quad 0.0123) + (0.1099)*(-0.087) + (-0.0315)*(-0.0033)] / 10 \\
&= 0.0002
\end{aligned}$$

Population coefficient of correlation according to the covariance and standard deviation for capital values and vacancy rates of super regional shopping centres

$$\begin{aligned}
\rho &= \sigma_{xixii} / (\sigma_{xi} * \sigma_{xii}) \\
&= 0.0002 / 0.0852 \\
&= 0.160
\end{aligned}$$

Supply Macroeconomic Analysis

With the use of Table 1 statistic, the correlation analysis for GDP growth rates and capital values of super regional shopping centres statistical analysis was conducted as follows.

Growth rate variance and standard deviation

N = 10

Table 4: Population Mean

Year	GDP (Yi)	Yi-m
2003	0.028	-0.005
2004	0.061	0.028
2005	0.043	0.010
2006	0.059	0.026
2007	0.065	0.032
2008	0.029	-0.004
2009	-0.063	-0.096
2010	0.040	0.007
2011	0.046	0.013
2012	0.026	-0.007
Total	0.334	0.000

Population mean (m) for GDP growth rates (Yi) as calculated on Table 4

$$\mu = \sum(i=1)^N(Yi)/N$$

$$= [(0.028) + (0.061) + (0.043) + (0.059) + (0.065) + (0.029) + (-0.063) + (0.040) + (0.046) + (0.026)] / 10$$

$$= 0.033$$

Table 5: Population Variance

Year	Yi-m	(Yi-m) ²
2003	-0.005	0.0000
2004	0.028	0.0008
2005	0.010	0.0001
2006	0.026	0.0007
2007	0.032	0.0010
2008	-0.004	0.0000
2009	-0.096	0.0093
2010	0.007	0.0000
2011	0.013	0.0002
2012	-0.007	
Total	0.000	0.012

Population variance for GDP growth rates (Yi) as calculated according to Table 5 and population mean (m) for GDP growth rates (Yi)

$$\sigma^2 = \sum_{i=1}^N [(Y_i - \mu)^2] / N$$

$$= [(0.005-(0.033))^2 + (-0.028-(0.033))^2 + (0.010-(0.033))^2 + (0.026-(0.033))^2 + (0.032-(0.033))^2 + (-0.004-(0.033))^2 + (-0.096-(0.0472))^2 + (0.007-(0.033))^2 + (0.013-(0.033))^2 + (-0.007-(0.033))^2] / 9$$

$$= 0.0013$$

Population standard deviation for GDP growth rates (Yi) as calculated according to Population variance for GDP growth rates (Yi)

$$\sigma = \sqrt{\sigma^2}$$

$$= \sqrt{0.0013}$$

$$= 0.0366$$

Capital Values of Super Regional Shopping Centres' Variance and Standard Deviation

N = 10

Table 6: Population Mean

Year	Capital Values (Xi)	Xi-m
2003	0.196	0.047
2004	0.176	0.027
2005	0.278	0.128
2006	0.266	0.116
2007	0.190	0.040
2008	0.058	-0.092
2009	0.059	-0.091
2010	0.116	-0.034
2011	0.040	-0.110
2012	0.118	-0.032
Total	1.496	0.000

Population mean (m) for capital values of super regional shopping centres (Xi) as calculated on

Table 6

$$\mu = \sum_{i=1}^N (Xi) / N$$

$$= [(0.196) + (0.176) + (0.278) + (0.266) + (0.190) + (0.058) + (0.059) + (0.116) + (0.040) + (0.118)] / 10$$

$$= 0.150$$

Table 7: Population Variance

Year	Xi-m	(Xi-m)²
2003	0.047	
2004	0.027	0.0007
2005	0.128	0.0164
2006	0.116	0.0134
2007	0.040	0.0016
2008	-0.092	0.0084
2009	-0.091	0.0083
2010	-0.034	0.0011
2011	-0.110	0.0121
2012	-0.032	0.0010
Total	0.000	0.0631

Population variance for capital values of super regional shopping centres (Xi) as calculated according to Table 7 and population mean (m) for GDP growth rates (Xi)

$$\begin{aligned}
 \sigma^2 &= \sum(i = 1)^N [(Xi - \mu)^2] / N \\
 &= [(0.047-(0.150))^2 + (0.027-(0.150))^2 + (0.128-(0.150))^2 + (0.116-(0.150))^2 + (0.040-(0.150))^2 \\
 &\quad + (-0.092-(0.150))^2 + (-0.091-(0.150))^2 + (-0.034-(0.150))^2 + (-0.110-(0.150))^2] / 9 \\
 &= 0.0070
 \end{aligned}$$

Population standard deviation for capital values of super regional shopping centres (Xi) is calculated according to the GDP growth rates (Yi)

$$\begin{aligned}
 \sigma &= \sqrt{\sigma^2} \\
 &= \sqrt{0.0070} \\
 &= 0.0837
 \end{aligned}$$

Table 8: Population Covariance

Year (Yi-m)	Yi-m	Year (Xi-m)	Xi-m	Lag Results	(Yi-Ym)(Xi-Xm)
2003	-0.0054	2004	0.0268	Lag1	-0.0001
2004	0.0276	2005	0.1282	Lag2	0.0035
2005	0.0096	2006	0.1160	Lag3	0.0011
2006	0.0256	2007	0.0403	Lag4	0.0010
2007	0.0316	2008	-0.0917	Lag5	-0.0029
2008	-0.0044	2009	-0.0910	Lag6	0.0004
2009	-0.0964	2010	-0.0337	Lag7	0.0033
2010	0.0066	2011	-0.1098	Lag8	-0.0007
2011	0.0126	2012	-0.0315	Lag9	-0.0004
				Total	0.0052

Population covariance for GDP growth rates and capital values of super regional shopping centres as illustrated on Table 8

$$\begin{aligned}
 \sigma_{yixi} &= \sum(i=1)^N [(Y(i) - \mu_{yi})(X(ii) - \mu_{xii})] / N \\
 &= [(-0.0054)*(0.0268) + (0.0276)*(0.1282) + (0.0096)*(0.1160) + (0.0256)*(0.0403) + \\
 &\quad (0.0316)*(-0.0917) + (-0.0044)*(-0.0910) + (-0.0964)*(-0.0337) + (0.0066)*(- \\
 &\quad 0.1098) + (0.0126)*(-0.0315)] / 9 \\
 &= 0.0006
 \end{aligned}$$

Population coefficient of correlation according to the covariance and standard deviation for GDP growth rates and capital values of super regional shopping centres

$$\begin{aligned}
 \rho &= \sigma_{yixi} / (\sigma_{yi} * \sigma_{xi}) \\
 &= 0.006 / (0.0366 * 0.0837) \\
 &= 0.187
 \end{aligned}$$

Changes in Prime Interest Rates and Changes in Capital Values Statistical Correlation Analysis on a Year Lag

With the use of Table 1 statistics and the GDP growth rates and capital values statistical correlation analysis on a year lag; the changes in prime interest rates in relation to changes in capital values of super regional shopping centres on a year lag yielded the following results.

Population mean (μ) for prime interest rates (Z_i)

$$\mu = \sum_{i=1}^N (Z_i) / N$$

$$= 0.118$$

Population variance for prime interest rates (Z_i)

$$\sigma^2 = \sum_{i=1}^N [(Z_i - \mu)^2] / N$$

$$= 0.0005$$

Population standard deviation for prime interest rates (Z_i)

$$\sigma = \sqrt{\sigma^2}$$

$$= 0.0215$$

For the capital values of super regional shopping centres statistical analysis, the population mean, population variance and standard deviation calculated on the GDP growth rates and capital values statistical correlation analysis on a Year Lag is used. This due to the fact that the capital values of super regional shopping centres statistical analysis is the constant variable measured in relation to GDP growth rates and prime interest rates.

Therefore the covariance and correlation coefficient of Prime Interest Rates and capital values of super regional shopping centres is as follows.

Population covariance for prime interest rates and capital values of super regional shopping centres

$$\sigma_{zixi} = \sum(i = 1)^N [(z(i) - \mu_{zi})(X(i) - \mu_{xi})]/N$$

$$= 0.0004$$

Population correlation coefficient for prime interest rates and capital values of super regional shopping centres

$$\rho = \sigma_{zixi}/(\sigma_{zi} * \sigma_{xi})$$

$$= -0.242$$

Demand Macroeconomic Analysis

Changes in CPI Inflation Rates and Changes in Vacancy Rates Statistical Correlation Analysis on a Year Lag

With the use of Table 3 statistics and the GDP growth rates and capital values statistical correlation analysis on a year lag; the yielded the changes in CPI inflation rates and changes in vacancy rates statistical correlation analysis on a year lag following results.

Population mean (m) for CPI inflation rates (Y_{ii})

$$\mu = \sum(i = 1)^N (Y_{ii})/N$$

$$= 0.046$$

Population variance for CPI inflation rates (Y_{ii})

$$\sigma^2 = \sum(i = 1)^N [(Y_{ii} - \mu)^2]/N$$

$$= 0.0010$$

Population standard deviation for CPI inflation rates (Y_{ii})

$$\sigma = \sqrt{\sigma^2}$$
$$= 0.0315$$

Population mean (m) for vacancy rates (X_{ii})

$$\mu = \sum(i = 1)^N (X_{ii})/N$$
$$= 0.029$$

Population variance for vacancy rates (X_{ii})

$$\sigma^2 = \sum(i = 1)^N [(X_{ii} - \mu)^2]/N$$
$$= 0.0001$$

Population standard deviation for vacancy rates (X_{ii})

$$\sigma = \sqrt{\sigma^2}$$
$$= 0.0111$$

Population covariance for CPI Inflation rates and vacancy rate of super regional shopping centres

$$\sigma_{zixi} = \sum(i = 1)^N [(Y_{ii}) - \mu_{yii})(X_{ii} - \mu_{xii})]/N$$
$$= -0.0002$$

Population correlation coefficient for CPI inflation rates and vacancy rates of super regional shopping centres

$$\rho = \sigma_{yixii}/(\sigma_{yii} * \sigma_{xii})$$

$$= -0.681$$

Changes in Retail Sales (YoY) and Changes in Vacancy Rates Statistical Correlation Analysis on a Year Lag

With the use of Table 3 statistics and the GDP growth rates and capital values statistical correlation analysis on a year lag; the yielded changes in retail sales and changes in vacancy rates statistical correlation analysis on a year lag following results.

Population mean (m) for retail sales (YoY) (Zii)

$$\mu = \sum(i = 1)^N(Zii)/N$$

$$= 0.103$$

Population variance for retail sales (YoY) (Zii)

$$\sigma^2 = \sum(i = 1)^N[(Zii - \mu)^2]/N$$

$$= 0.0009$$

Population standard deviation for retail sales (YoY) (Zii)

$$\sigma = \sqrt{\sigma^2}$$

$$= 0.0300$$

Population mean (m) for vacancy rates (Xii)

$$\mu = \sum(i = 1)^N (Xii) / N$$

$$= 0.029$$

Population variance for vacancy rates (Xii)

$$\sigma^2 = \sum(i = 1)^N [(Xii - \mu)^2] / N$$

$$= 0.0001$$

Population standard deviation for vacancy rates (Xii)

$$\sigma = \sqrt{\sigma^2}$$

$$= 0.0111$$

Population covariance for Retail Sales (YoY) (Zii) and vacancy rate (Xii) of super regional shopping centres

$$\sigma_{zixi} = \sum(i = 1)^N [(Z(ii) - \mu_{zii})(X(ii) - \mu_{xii})] / N$$

$$= -0.0001$$

Population correlation coefficient for CPI inflation rates and vacancy rates of super regional shopping centres

$$\rho = \sigma_{zixi} / (\sigma_{zii} * \sigma_{xii})$$

$$= -0.259$$

Due to the fact that the study statistically proved that both supply and demand macroeconomic variable are significant for the redevelopment of super regional shopping centres in South Africa, utilising study area Johannesburg West Region C. The standard deviation for measured variables is:

$$\begin{aligned}\sigma((Y)(Z)(X)) &= supply[(\sigma_{Yi} + \sigma_{Zi} + \sigma_{Xi})] + demand[\sigma_{Yii} + \sigma_{Zii} + \sigma_{Xii}]/6 \\ &= [(0.0366) + (0.0215) + (0.0837)] + [(0.0315) + (0.0300) + (0.0111)]/6 \\ &= 0.0357\end{aligned}$$

APPENDIX D: TWO-WAY MULTIVARIATE ANOVA ANALYSIS

Supply Macroeconomic Two-way Multivariate Anova Analysis

Table 9, are statistics from Investment Property Databank Ltd (2013) (Xi), Liberta (2013) (Yi) and Liberta (Zi) (2013) which are required for variable input for the two-way multivariate anova analysis.

Table 9: Supply Population Sum

Lag Results	GDP Growth Rates (Yi)	GDP Growth Rates (Yi)²	Prime Interest Rates (Zi)	Prime Interest Rates (Zi)²	Capital Values of Super Regional Shopping Centre (Xi)	Capital Values of Super Regional Shopping Centre (Xi)²	Sum of [(Yi) + (Zi) + (Xi)]	Squared Sum of [(Yi)² + (Zi)² + (Xi)²]
lag1	0.028	0.001	0.155	0.024	0.176	0.031	0.359	0.056
lag2	0.061	0.004	0.110	0.012	0.278	0.077	0.449	0.093
lag3	0.043	0.002	0.105	0.011	0.266	0.071	0.414	0.083
lag4	0.059	0.003	0.110	0.012	0.190	0.036	0.359	0.052
lag5	0.065	0.004	0.130	0.017	0.058	0.003	0.253	0.024
lag6	0.029	0.001	0.150	0.023	0.059	0.003	0.238	0.027
lag7	-0.063	0.004	0.140	0.020	0.116	0.013	0.193	0.037
lag8	0.040	0.002	0.100	0.010	0.040	0.002	0.180	0.013
lag9	0.046	0.002	0.095	0.009	0.118	0.014	0.259	0.025
Total	0.308	0.023	1.095	0.137	1.300	0.251	2.703	0.411

Table 9 illustrates the sum values required to statistically analyse the supply macroeconomic two-way multi variate anova analysis which were analysed as follows:

Population sum for GDP Growth Rate (Yi)

$$p = \sum Y_i$$

$$= (0.028) + (0.061) + (0.043) + (0.059) + (0.065) + (0.029) + (-0.063) + (0.040) + (0.046)$$

$$= 0.308$$

Population sum of squares for GDP Growth Rate (Y_i)²

$$\begin{aligned} p &= \sum (Y_i)^2 \\ &= (0.028)^2 + (0.061)^2 + (0.043)^2 + (0.059)^2 + (0.065)^2 + (0.029)^2 + (-0.063)^2 + (0.040)^2 + \\ &\quad (0.046)^2 \\ &= 0.023 \end{aligned}$$

Population sum for Prime Interest Rates (Z_i)

$$\begin{aligned} p &= \sum Z_i \\ &= (0.155) + (0.110) + (0.105) + (0.110) + (0.130) + (0.150) + (0.140) + (0.100) + (0.095) \\ &= 1.095 \end{aligned}$$

Population sum of squares for Prime Interest Rates (Z_i)²

$$\begin{aligned} p &= \sum (Z_i)^2 \\ &= (0.155)^2 + (0.110)^2 + (0.105)^2 + (0.110)^2 + (0.130)^2 + (0.150)^2 + (0.140)^2 + (0.100)^2 + (0.095)^2 \\ &= 0.137 \end{aligned}$$

Population sum for capital values of super regional shopping centres (X_i)

$$p = \sum X_i$$

$$= (0.176) + (0.278) + (0.266) + (0.190) + (0.058) + (0.059) + (0.116) + (0.040) + (0.118)$$

$$= 0.251$$

Population sum of squares for capital values of super regional shopping centres (Xi)²

$$p = \sum (Xi)^2$$

$$= (0.176)^2 + (0.278)^2 + (0.266)^2 + (0.190)^2 + (0.058)^2 + (0.059)^2 + (0.116)^2 + (0.040)^2 + (0.118)^2$$

$$= 1.300$$

$$p = \sum (Yi) + (Zi) + (Xi)$$

$$= 2.703$$

$$p = \sum (Yi)^2 + (Zi)^2 + (Xi)^2$$

$$= 0.411$$

F value Analyses

Total sum analyses the relationship within for GDP growth rates (Yi) Interest Rates (Zi) and capital values of super regional shopping centres (Xi) according to Table 10

$$MS(ts)y_iz_ix_i = (\sum Y_i Z_i X_i)$$

$$= 0.411$$

Total sum of squares analyses the relationship within for GDP growth rates (Yi) Interest Rates (Zi) and capital values of super regional shopping centres (Xi) according to Table 10

$$MS[(t)y]_iz_ix_i = [\sum (Y_i Z_i X_i)^2] / N$$

$$= [(2.703)^2]/27$$

$$= 0.271$$

Sum of squared values for columns = Sum of squared values for rows, therefore:

Sum of squared values for columns analyses the relationship within for GDP growth rates (Yi) Interest Rates (Zi) and capital values of super regional shopping centres (Xi) according to Table 10

$$MS[(c)y]_{iz_ix_i} = [(\sum Y_i Z_i X_i)^2]/N$$

$$= [(0.411)^2]/3$$

$$= 0.056$$

Sum of squared values for rows analyses the relationship within for GDP growth rates (Yi) Interest Rates (Zi) and capital values of super regional shopping centres (Xi) according to Table 10

$$MS[(r)y]_{iz_ix_i} = [(\sum Y_i Z_i X_i)^2]/N$$

$$= [(0.411)^2]/9$$

$$= 0.021$$

Table 11: Analysis of Variables

Source of variance	Sum of squares (SS)	Degrees of freedom (df)	Mean square MS= (SS)/(df)
Between columns	$[(MS(c)y_{iz_ix_i}) - (MS(t)y_{iz_ix_i})] = 0.056 - 0.271 = -0.215$	$u - 1 (=2)$	-0.108
Between rows	$[(MS(r)y_{iz_ix_i}) - (MS(t)y_{iz_ix_i})] = 0.019 - 0.271 = -0.252$	$v - 1 (= 8)$	-0.032
Residual Mean	$[(MS(t)y_{iz_ix_i}) - ((MS(c)y_{iz_ix_i}) + (MS(r)y_{iz_ix_i}))] = [(0.271) - ((0.056 + 0.019))] = 0.196$	$(u-1)(v-1) (=16)$	0.012
Total	$[(MS(ts)y_{iz_ix_i}) - (MS(t)y_{iz_ix_i})] = 0.411 - 0.271 = 0.140$	$(uv)-1= [(27) - 1] =26$	0.005

Variance ratio test to obtain F values:

(1) **For between columns MS(c):** $F = \text{Between columns mean square} / \text{Residual mean square}$

$$= -0.108 / 0.012 = -9.000$$

(2) **For between rows MS(r):** $F = \text{Between rows mean square} / \text{Residual mean square}$

$$= -0.032 / 0.012 = -2.667$$

Therefore:

$$F \text{ value} = [MS(c)]/[MS(r)]$$

$$= (-9.000)/(-2.667)$$

$$= 3.374$$

Demand Macroeconomic Two-way Multivariate Anova Analysis

Table 12 are statistics from Investment Property Databank Ltd (2013) (Xii), Statistics South Africa (2013) (Yii), and Inflation.eu (Zii) (2013) which are required for variable input for the two-way multivariate anova analysis.

Table 12

Lag Results	CPI Inflation Rates(Yii)	CPI Inflation Rates (Yii)²	Retail Sales (YOY) (Zii)	Retail Sales (YOY) (Zii)²	Vacancy Rates of Super Regional Shopping Centre (Xii)	Vacancy Rates of Super Regional Shopping Centre (Xii)²	Total Sum [(Yii) + (Zii) + (Xii)]	Total Sum [(Yii)² + (Zii)² + (Xii)²]
lag1	-0.016	0.000	0.107	0.011	0.047	0.002	0.138	0.014
lag2	0.022	0.000	0.131	0.017	0.030	0.001	0.183	0.019
lag3	0.020	0.000	0.102	0.010	0.030	0.001	0.152	0.012
lag4	0.048	0.002	0.153	0.023	0.009	0.000	0.210	0.026
lag5	0.076	0.006	0.124	0.015	0.017	0.000	0.217	0.021
lag6	0.093	0.009	0.117	0.014	0.028	0.001	0.238	0.023
lag7	0.060	0.004	0.049	0.002	0.017	0.000	0.126	0.006
lag8	0.034	0.001	0.070	0.005	0.038	0.001	0.142	0.007
lag9	0.064	0.004	0.091	0.008	0.026	0.001	0.181	0.013
Total	0.401	0.027	0.944	0.107	0.242	0.008	1.588	0.141

With the use of Table 12, follow the same process as the supply macroeconomic two-way multivariate anova analysis.

F value results:

$$\begin{aligned}
 F - \text{value} &= [MS(c)(y_i z_i x_i)] / (MS(r)(y_i z_i x_i)] \\
 &= \frac{0.988}{1.110} \\
 &= 0.089
 \end{aligned}$$

